
**FACILITY DESCRIPTIONS
AND UPDATED COST ESTIMATES
FOR THOMES-NEWVILLE RESERVOIR PROJECT**

**Prepared by the CALFED Storage and Conveyance Refinement Team
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TABLE OF CONTENTS

| | |
|--|----|
| INTRODUCTION | 1 |
| PROJECT BACKGROUND | 2 |
| FACILITIES DESCRIPTIONS | 4 |
| Existing Facilities | 5 |
| Project Location | 5 |
| Principal Facilities | 6 |
| Newville Reservoir and Dam--1.84 maf | 7 |
| Spillway | 7 |
| Inlet Outlet Works | 8 |
| Emergency Release | 8 |
| Saddle Dams | 8 |
| Newville Reservoir and Dam--3.08 maf | 8 |
| Spillway | 9 |
| Inlet-Outlet Works | 9 |
| Emergency Release | 9 |
| Saddle Dams | 10 |
| Newville Pumping-Generating Plant | 10 |
| Thomes Creek Diversion Structure and Canal | 10 |
| Tehenn Reservoir | 11 |
| Tehenn Pumping-Generating Plant | 12 |
| Tehenn Canal | 12 |
| Black Butte Pumping-Generating Plant | 12 |
| Black Butte Canal | 13 |
| Sour Grass Pumping-Generating Plant | 13 |
| Sour Grass Canal | 14 |
| Road Relocations | 14 |
| COST ESTIMATE | 14 |
| Cost Estimate Methodology | 15 |
| General | 15 |
| Right-of-Way Costs | 15 |
| Canal Costs | 16 |
| Pumping-Generating Plant Costs | 16 |
| Reservoir Clearing | 17 |
| Contingencies and Other Costs | 17 |
| Preliminary Cost Findings | 18 |

| | |
|--|----|
| ENVIRONMENTAL CONSIDERATIONS | 19 |
| Wildlife | 19 |
| Fish, Amphibians, Reptiles, and Invertebrates | 19 |
| General Wildlife | 21 |
| Sensitive and Listed Fish and Wildlife Species | 21 |
| Vegetation | 22 |
| Sensitive and Listed Plant Species | 23 |
| Wetlands | 23 |
| Cultural Resources | 24 |
| BIBLIOGRAPHY | 25 |

D
R
A
F
T

LIST OF TABLES

| | |
|----------|---|
| Table 1 | Physical Features--Thomes-Newville Reservoir Project |
| Table 2a | Estimated Costs--Thomes-Newville Reservoir Project (1.84 maf) |
| Table 2b | Estimated Costs--Thomes-Newville Reservoir Project (3.08 maf) |
| Table 3 | Estimated Cost Summary--Thomes Newville Reservoir Project |

LIST OF FIGURES

| | |
|----------|---|
| Figure 1 | Project Location Map--Thomes-Newville Reservoir Project |
| Figure 2 | Thomes-Newville Reservoir Project--Project Features |
| Figure 3 | Area-Capacity Curves--Newville Reservoir |
| Figure 4 | Thomes-Newville Reservoir Project--Schematic Profile |

D
R
A
F
T

INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for Thomes-Newville Reservoir Project* has been prepared as part of the Storage and Conveyance Component Refinement Task of the CALFED Bay-Delta Program (CALFED or Program). CALFED's mission is to develop a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) system.

This report summarizes the principal features, estimated costs, and environmental considerations of constructing the Thomes-Newville Reservoir Project. The Thomes-Newville Reservoir Project would develop flows from Stony and Thomes Creeks as well as surplus flows from the Sacramento River. This evaluation considered two alternative storage capacities at Newville Reservoir: 1.84 million acre-feet (maf), and 3.08 maf. The general location of the Thomes-Newville Reservoir Project is shown in Figure 1.

This evaluation and others being performed by CALFED are intended to provide a facilities evaluation and updated cost estimates of representative storage and conveyance components. The specific objectives of the Thomes-Newville Reservoir Project evaluation are (1) to provide an updated cost estimate which represents a cost within the range expected if the project were to be constructed today and (2) to enable CALFED to equally compare this project against other projects that might be considered as part of a long-term CALFED solution strategy.

The cost estimate for the Thomes-Newville Reservoir Project was determined by escalating the costs in the Department of Water Resources (DWR), Division of Design and Construction, September 1981 report, *SWP Future Supply Program, Thomes-Newville Plan, Addendum to the Cost Estimate for Thomes-Newville Project Plan I and II, Vol. I, Memorandum Report, June 1980*, and in the DWR, Northern District, November 1980 report, *Thomes-Newville and Glenn Reservoir Plans, Engineering Feasibility*. The cost estimates presented by DWR in these reports

have been reviewed and adapted for this evaluation. Modifications have been made to reflect current design and safety standards where appropriate.

A preliminary evaluation of the environmental considerations associated with this project has also been included in this report. Fish, wildlife, plant, and cultural resources that could be affected have been described and potential impacts have been identified. The information for the evaluation of environmental considerations was gathered from existing literature and databases.

PROJECT BACKGROUND

Water supply planning on the Stony and Thomes Creeks watersheds dates back to the 1860s. The first canal diverted water from Stony Creek in 1866, and in the late 1890s several irrigation districts had been formed to divert water from Stony Creek and Thomes Creek.

Variations of the Thomes-Newville Reservoir Project were investigated in the early 1900s. In 1957, DWR completed *The California Water Plan* (Bulletin No. 3), a 10-year study investigating California's water resources and formulating plans for their orderly development. This report included Paskenta Reservoir on Thomes Creek, which would spill excess flows into a Newville Reservoir located on the North Fork Stony Creek. Under that proposed plan, Newville Reservoir supplies would be supplemented by additional diversions from upper Stony Creek and Grindstone Creek, a tributary to Stony Creek.

After completing Bulletin No. 3, DWR focused on identifying potential sites within the Sacramento Valley for storage of water diverted from the Eel, Trinity, and Klamath Rivers. One possibility was the Millsite-Newville Reservoir which required dams on Stony Creek and North Fork Stony Creek. Detailed investigations revealed, however, that the topography of the Millsite location was not as favorable as the Rancheria Dam site three miles upstream. DWR formally introduced the combined Newville and Rancheria Reservoirs as the Glenn Reservoir Complex in

the 1961 report, *Progress Report on North Coastal Area Investigation*. In 1964, DWR published a report titled *North Coastal Area Investigation* (Bulletin No. 136) which suggested that upper Eel River water could be routed either through Clear Lake or elements of Glenn Reservoir to supplement Delta water supplies.

In 1975, DWR began to reevaluate tributary storage opportunities on the upper Sacramento River. DWR completed a report titled *Major Surface Water Development Opportunities in the Sacramento Valley* which identified four plans in detail: (1) the Tributary Storage Plan, (2) the Tuscan Buttes Reservoir, (3) the Glenn Reservoir-River Diversion Plan, and (4) the Colusa Reservoir-River Diversion Plan. The Glenn Reservoir-River Diversion Plan was the first formal consideration of using the Glenn Reservoir for offstream storage of Sacramento River water.

The Thomes-Newville Reservoir Plan Concept was completed by DWR in 1978. This plan was a much smaller project than the Glenn Reservoir-River Diversion Plan. DWR's perception at that time was that the Thomes-Newville Reservoir Plan would be easier to implement and would not preempt the U.S. Bureau of Reclamation's (Reclamation) planned West Sacramento Canal Unit, which was to supply Sites Reservoir in Colusa County through the Tehama-Colusa Canal.

In November 1980, DWR's Northern District released a report titled *Thomes-Newville and Glenn Reservoir Plans, Engineering Feasibility* (Glenn Reservoir Feasibility Report) which presented three water supply plans: (1) the Thomes-Newville Plan, (2) the Glenn Reservoir Plan, and (3) the staged Glenn Reservoir Plan. This report assessed the physical and operational feasibility of these plans. DWR concluded that both the Thomes-Newville and Glenn Reservoirs were feasible from an engineering standpoint. Further, DWR stated in that report that the Thomas-Newville Plan would better meet expected future demands. Construction was tentatively scheduled for the mid-1990s.

The conclusions of the 1980 DWR report led to the preparation by DWR's Division of Design and Construction of a memorandum report titled *SWP Future Supply Program, Thomes-Newville Plan: Addendum to the Reconnaissance Study and Cost Estimate for Thomes-Newville Project Plan I and II, Vol. I, Memorandum Report, June 1980* (Thomes-Newville Plan Report) which developed cost estimates for Newville Dam and Reservoir with three alternative water surface elevations: 870, 900, and 920 feet above mean sea level (MSL). The Newville Dam and Reservoir alternative, with a water surface elevation of 900 feet MSL, serves as the basis of the Newville Reservoir configurations utilized in this evaluation.

FACILITIES DESCRIPTIONS

This section provides an overview of the major features of the Thomes-Newville Reservoir Project and of existing projects in the Thomes and Stony Creek watershed. The principal reference used for this synopsis is the Thomes-Newville Plan Report, which provides a cost estimate and facilities description for the Newville Reservoir. Additional information for associated facilities has been taken from the Glenn Reservoir Feasibility Report.

The Thomes-Newville Reservoir Project has been evaluated at two storage capacities: 1.84 maf and 3.08 maf. The Thomes-Newville Project would function as storage for available flows from Thomes Creek, North Fork Stony Creek, Stony Creek, and as an off-stream storage facility for available flows from the Sacramento River. The Thomes-Newville Reservoir facilities include the following: Newville and Tehenn Reservoirs located on North Fork Stony Creek; a diversion facility from Thomes Creek to Newville Reservoir; a two-way conveyance facility from Tehenn Reservoir to the existing Black Butte Reservoir on the mainstem of Stony Creek; and a two-way conveyance canal facility from the Tehama-Colusa Canal to Black Butte Reservoir.

EXISTING FACILITIES

Three storage facilities have been developed on Stony Creek. These are the East Park, Stony Gorge, and Black Butte Reservoirs. No storage facilities have been developed on Thomes Creek.

The East Park Reservoir was constructed by the U.S. Reclamation Service (predecessor to the U.S. Bureau of Reclamation) in 1909 in the upper watershed of the mainstem of Stony Creek. This reservoir became the first facility of the Orland Project. Stony Gorge Reservoir, completed in 1928, and Black Butte Reservoir, completed in 1970, are also facilities of the Orland Project. The Orland Project, part of the Central Valley Project (CVP), serves approximately 20,000 acres of irrigated land around the town of Orland in Glenn County. This area is located west of the Sacramento River about 100 miles north of Sacramento (see Figure 1).

Development of the three existing reservoirs on Stony Creek resulted from investigations by the U.S. Geological Survey (USGS), the U.S. Reclamation Service and the U.S. Army Corp of Engineers (COE). Investigations by the USGS and the Reclamation Service in the early 1900s led to the development of East Park and Stony Gorge Reservoirs. Investigations by the COE, beginning in the mid-1940s, led to development of Black Butte Reservoir, in part for flood control on lower Stony Creek. The Black Butte Reservoir now serves as the main regulating facility for the distribution system of the Orland Project.

PROJECT LOCATION

The Thomes-Newville Reservoir Project would be located on the North Fork Stony Creek and would develop flows of the North Fork and mainstem of Stony Creek and the flows of Thomes Creek. Additional water would be developed from surplus flows diverted from the Sacramento River at the Red Bluff Diversion Facility.

The drainage area of Stony Creek upstream of Black Butte Dam (which includes the North Fork) is about 740 square miles and has an annual runoff of about 400,000 acre-feet per year. The drainage area includes portions of Lake, Colusa, Glenn, and Tehama Counties at elevations ranging from 400 to 6,300 feet above MSL. The Thomes Creek drainage basin is located north and west of the Newville Reservoir site and drains an area of roughly 194 square miles, with an average annual runoff of about 200,000 acre-feet upstream of the stream gage at the Town of Paskenta. The diversion facility on Thomes Creek would be located 5 miles upstream of the Paskenta gage and would receive about 97 percent of the flows estimated to occur at the Paskenta gage.

The Newville Dam site is located about 10 miles upstream of the Black Butte Dam. Newville Dam would fill a low gap in the north-south trending Rocky Ridge. The dam site is within the Coast Range geomorphic province immediately west of the boundary with the Great Valley geomorphic province. This is an area of low-to-moderate seismicity. There are several known faults in the area, including the Stony Creek Fault, Coast Range Thrust Fault, and Paskenta Fault Zone. It is possible that additional undiscovered faults could be located in this area.

PRINCIPAL FACILITIES

This section provides a description of the principal facilities associated with the Thomes-Newville Reservoir Project. Table 1 provides a summary of the physical characteristics of the major features of the Thomes-Newville Project for the two alternative storage capacities of 1.84 maf and 3.08 maf. Figure 2 shows the locations of the features which would be developed by the Thomes-Newville Reservoir Project.

There would be four water sources for the Newville Reservoir. Flows from the North Fork Stony Creek would discharge directly into Newville Reservoir. Thomes Creek flows would be diverted from Thomes Creek and conveyed to Newville Reservoir by a gravity canal. Mainstem Stony

Creek flows would be conveyed from Black Butte Reservoir to Newville Reservoir via Tehenn Canal, Tehenn Pumping-Generating Plant, Tehenn Reservoir, and Newville Pumping-Generating Plant. Finally, Sacramento River flows would be diverted into the Tehama-Colusa Canal and conveyed into Black Butte Reservoir via Sour Grass Canal and Sour Grass Pumping-Generating Plant. From Black Butte Reservoir, the Sacramento River water would be conveyed to Thomes-Newville Reservoir via the Tehenn Canal and Reservoir. Figure 3 shows a schematic representation of the Thomes-Newville Reservoir Project.

Newville Reservoir and Dam--1.84 maf

Newville Reservoir, with a storage capacity of 1.84 maf, would have a normal pool elevation of 900 feet above MSL. The reservoir would have a surface area of 13,900 acres at normal pool. The area-capacity curves for Newville Reservoir are shown on Figure 4.

Newville Dam would consist of a zoned earthfill dam with an embankment volume of about 16 million cubic yards, which would rise 320 feet above the existing streambed. The crest of the dam would be at an elevation of 920 feet above MSL, with a crest length of approximately 2,400 feet.

Spillway

The spillway for the 1.84 maf Newville Reservoir would have a maximum capacity of 35,700 cfs and would be located 200 feet west of the right dam abutment. The spillway would consist of two submerged radial gates in a rectangular reinforced concrete-lined channel. The gates would be 20 feet wide by 30 feet high. The gate sill would be at an elevation of 850 feet above MSL. The emergency spillway would consist of two uncontrolled weirs, each 20 feet long at a crest elevation of 905 feet above MSL. The emergency spillway would have a capacity of 8,000 cfs.

The gated spillway and the emergency spillway would discharge into a common concrete-lined tailrace and stilling basin.

Inlet Outlet Works

The inlet-outlet works for Newville Dam would have a capacity of 5,000 cfs to convey water pumped into the reservoir as well as to facilitate releases from the reservoir. The primary features of the inlet-outlet works would be a 2,100 foot-long tunnel through the right abutment of the dam and a sloping intake conduit with nine evenly spaced levels of inlets between the minimum and normal pool elevations.

Emergency Release

In the event of a potential emergency condition, the outlet works and spillway must be capable of evacuating ten percent of the maximum water depth within 10 days, as required by DWR's Division of Safety of Dams. With this criterion, the emergency drawdown release for Newville Reservoir would be about 21,000 cfs. All of this release could be handled by the gated spillway so no adjustment to the outlet works would be required.

Saddle Dams

For a storage capacity of 1.84 maf, only one saddle dam would be required, the Burrow's Gap Saddle Dam. Burrow's Gap Saddle Dam would be located about three miles south of Newville Dam at a saddle in Rocky Ridge. It would consist of a 70-foot high earthfill dam with an embankment volume of approximately 197,000 cubic yards. It would have a crest length of approximately 520 feet at an elevation of 920 feet above MSL.

Newville Reservoir and Dam--3.08 maf

Newville Reservoir, with a storage capacity of 3.08 maf, would have a normal pool elevation of 980 feet above MSL. The reservoir would have a surface area of 16,700 acres at normal pool. Figure 4 shows the area-capacity curves for Newville Reservoir, and Figure 3 contains a schematic of the Thomes-Newville Reservoir Project. Both figures contain information for the 1.84 and 3.08 maf reservoirs.

Newville Dam, for the 3.08 maf alternative, would be an earthfill embankment structure with a volume of approximately 25 million cubic yards. The dam would rise 400 feet above the existing streambed to an elevation of 1,000 feet above MSL. The crest length of the dam would be approximately 3,200 feet.

Spillway

The maximum spillway capacity would be 35,700 cfs for the 3.08 maf Newville Reservoir, identical to the 1.84 maf reservoir. The configuration and dimensions of the submerged radial gates would also be the same for both alternative storage volumes. The sill of the gates would be at an elevation of 930 feet above MSL. The emergency spillway would consist of two uncontrolled weirs, each 20 feet long at an elevation of 985 feet above MSL. As with the 1.84 maf reservoir, the emergency spillway for the 3.08 maf reservoir would have a capacity of 8,000 cfs. The gated spillway and the emergency spillway would discharge into a common concrete lined tailrace and stilling basin.

Inlet-Outlet Works

The configuration and capacity (5,000 cfs) of the inlet-outlet works for the 3.08 maf reservoir would be identical to the inlet-outlet works for the 1.84 maf reservoir.

Emergency Release

The emergency release requirement of the 3.08 maf reservoir would be 32,000 cfs. This release can be made through the gated spillway and the inlet-outlet works of the dam; therefore, no adjustment to the outlet works was required to comply with DWR's Division of Safety of Dams.

Saddle Dams

Increasing the storage capacity to 3.08 maf would require 10 saddle dams. The largest saddle dam would be Chrome Dike, with an earthfill embankment volume of approximately 2.9 million cubic yards. The remaining saddle dams would be located on Rocky Ridge on the eastern and northern boundaries of the reservoir.

Newville Pumping-Generating Plant

The configuration of the Newville Pumping-Generating Plant would be the same for either a 1.84 maf or 3.08 maf Newville Reservoir. The plant would be located at the toe of Newville Dam to lift water from Tehenn Reservoir into Newville Reservoir and to generate power from releases from Newville Reservoir into Tehenn Reservoir. The plant would have a total capacity of 5,000 cfs. For the 1.84 maf Newville Reservoir, the required total dynamic head would be 300 feet, with a power requirement of about 136,000 horsepower. For the 3.08 maf Newville Reservoir, the required total dynamic head would be 380 feet, with a power requirement of about 287,000 horsepower.

Thomes Creek Diversion Structure and Canal

The Thomes Creek Diversion Structure would be identical for either storage volume alternative. The diversion structure would be located in Thomes Creek approximately 9.0 miles upstream of the town of Paskenta.

The diversion structure would consist of a conventional concrete gravity dam founded in the Stony Creek Formation. The dam crest would be about 90 feet above the existing streambed at an elevation of 1,050 feet above MSL. A 500-foot wide overflow section with a crest elevation of 1,035 feet above MSL would be located on the left abutment. Two additional 20-foot wide and 50-foot high radial gates located in the right abutment could pass up to 41,000 cfs. The sill of the gates would be located 25 feet above the original streambed. These gates would be opened to allow flood flows to pass and flush accumulated sediment out of the diversion pool. During most of the winter, the gates would be closed so water could be diverted to Newville Reservoir.

A concrete-lined canal would convey water 13,000 feet from Thomes Creek to Newville Reservoir. The canal would have a rectangular cross-section 30 feet wide and 16.5 feet deep. The canal would have a capacity of 10,000 cfs.

Tehenn Reservoir

Tehenn Reservoir would be located on North Fork Stony Creek immediately downstream of Newville Dam. Tehenn Reservoir would back-water to the Newville Pumping-Generating Plant located at the base of Newville Dam, where the pumping-generating plant would lift the water into Newville Reservoir.

Tehenn Reservoir would have a gross storage capacity of 32,500 acre-feet at a normal pool elevation of 610 feet above MSL. Tehenn Dam would rise 112 feet above the original streambed. The dam would have a crest length of 2,500 feet and a total embankment volume of 2.6 million cubic yards.

The spillway for Tehenn Reservoir would be a concrete-lined ungated chute-type on the left abutment with a capacity of 50,000 cfs. The chute would extend 1,300 feet ending in a concrete stilling basin. The spillway crest length would be 250 feet. The inlet-outlet works for Tehenn

Dam would consist of a cut-and-cover steel-lined concrete conduit under the left abutment with a capacity of 5,000 cfs.

Tehenn Pumping-Generating Plant

The Tehenn Pumping-Generating Plant would lift water from Black Butte Reservoir and the Tehenn Canal into Tehenn Reservoir and would also generate power from releases from Tehenn Reservoir to Black Butte Reservoir. The plant would have a total capacity of 5,000 cfs. The total dynamic head would be 190 feet, with a power requirement of about 144,000 horsepower.

Tehenn Canal

Tehenn Canal would deliver a maximum flow of 5,000 cfs in either direction between Black Butte Reservoir and the Tehenn Pumping-Generating Plant. It would be approximately five miles long, and the alignment would roughly follow the natural channel of North Fork Stony Creek. The canal would be trapezoidal in shape and unlined. The canal would have an invert elevation of 410 feet above MSL, and the water surface elevation would fluctuate with the storage in Black Butte Reservoir. The minimum flood control drawdown of Black Butte Reservoir is at elevation 430 feet above MSL. The long canal and low invert elevation would allow continuous pumping from Black Butte Reservoir to Tehenn Reservoir at low water levels. The canal would require a maximum cut of 120 feet.

Black Butte Pumping-Generating Plant

The Black Butte Pumping-Generating Plant would lift water from the Black Butte Canal into Black Butte Reservoir and would generate power from releases from Black Butte Reservoir to the Black Butte Canal. The plant would be located just downstream of the existing Black Butte Dam and would be connected to the dam's inlet-outlet works by a new 1,800-foot tunnel. The

pumping-generating plant would have a capacity of 5,000 cfs. The total dynamic head would be 144 feet, with a power requirement of about 109,000 horsepower.

Black Butte Canal

The Black Butte Canal would be a two-way conveyance facility connecting the Black Butte Pumping-Generating Plant and Black Butte Reservoir with the Sour Grass Pumping-Generating Plant. The Black Butte Canal would have a capacity of 5,000 cfs, matching the capacity of the pumping-generating plants. The canal would have a total length of 4.5 miles between the Black Butte and Sour Grass Pumping-Generating Plants. The canal would be trapezoidal in shape and concrete lined. The invert elevation of the canal would be at an elevation of 310 feet above MSL, and the water surface elevation would be about 340 feet above MSL. Near Black Butte, the canal would require a maximum cut of about 190 feet.

Sour Grass Pumping-Generating Plant

The Sour Grass Pumping-Generating Plant would lift flow into the Black Butte Canal during pumping operations and would generate power during release operations from Black Butte Reservoir. Releases would be made through this plant and the Black Butte Pumping-Generating Plant to supply supplemental water from storage in Newville Reservoir for use in the Tehama-Colusa Canal.

The pumping-generating plant would have a capacity of 5,000 cfs. The total dynamic head would be 115 feet, with a power requirement of about 87,000 horsepower.

Sour Grass Canal

The Sour Grass Canal would convey water, in either direction, from the Tehama-Colusa Canal to the Sour Grass Pumping-Generating Plant. The canal would have a capacity of 5,000 cfs and would have a total length of 4.5 miles. The canal alignment would generally follow Sour Grass Creek. The canal would be trapezoidal in shape and concrete lined. The canal would have a water surface elevation of about 235 feet above MSL and an invert of about 205 feet above MSL.

Road Relocations

This area is sparsely populated with relatively few structures. Approximately eight miles of public roads exist within the inundation area of Newville Reservoir. The Paskenta-Round Valley Road, a paved two-lane county road, passes through the north end of the reservoir, and another county road crosses northwestward through the reservoir from the dam site to Paskenta-Round Valley Road. These roads would be relocated and upgraded to current county road standards. The total length of new road construction would be about 10 miles.

COST ESTIMATE

The cost estimates for the facilities identified in the previous sections are based on DWR's September 1981 Thomes-Newville Plan Report and DWR's November 1980 Glenn Reservoir Feasibility Report. Project costs not identified in the DWR reports are not included in the present updated cost estimate. Some of these additional costs include environmental documentation and mitigation, operation and maintenance, power, filling of the reservoir, recreational development, and interest during construction.

COST ESTIMATE METHODOLOGY

The 1981 DWR cost estimates have been reviewed and adapted for the present cost estimate update. Several items in the previous cost estimates have been modified to ensure that current design standards and safety factors were incorporated.

General

The cost estimates for the Thomes-Newville Reservoir Project were determined by escalating the costs provided in the 1980 and 1981 DWR reports to October 1996 dollars using the Reclamation's Construction Cost Trends (CCT) indices and by applying current unit costs to quantities found in these reports. Tables 2a and 2b provide a detailed breakdown of the estimated costs of the Thomes-Newville Reservoir Project, with a storage capacity of 1.84 and 3.08 maf, respectively. These tables include an updated cost estimate for each cost item identified in the previous cost estimates, along with the quantities of the cost item or an indication that the estimated cost has been developed through a lump sum approach. The table also includes the CCT index for the month and year in which the estimated cost was developed and for October 1996. The Reclamation cost indices are used to factor the previous cost estimate to October 1996 dollars. In some instances, only a unit cost has been provided, with no cost indices. In these cases, the unit cost has been taken from other sources. The far right-hand column of Tables 2a and 2b provide the cost reference for each cost item.

Right-of-Way Costs

Right-of-way costs of \$1,500 per acre were based on land use costs developed by Reclamation, Land Resource Branch (pers. comm. February 1997). Reclamation provided land use cost estimates at a subappraisal level for all storage and conveyance components reviewed by CALFED. The total project lands associated with the reservoirs include a buffer around the

maximum water surface area. The ratio of total project land acquired for a reservoir to maximum water surface area used in the cost estimate is 1.32, based on data from the September 1990 *Los Banos Grandes Facility Feasibility Report, Appendix A: Design and Cost Estimates* by DWR. The total right of way needed would be 18,350 and 22,060 acres for the 1.84 maf and 3.08 maf alternatives, respectively.

Canal Costs

To develop costs for Black Butte and Tehenn Canals the cost estimates provided in the Glenn Reservoir Facilities report were updated and factored by the following empirical equation:

$$\frac{(Cost)_1}{(Cost)_2} = \frac{Q_1^{3/4}}{Q_2^{3/4}}$$

Where Q is equal to capacity.

The capacities of the two canals in the 1980 report were 3,000 cfs. The empirical equation was used to factor the cost to a capacity of 5,000 cfs.

The cost factor formula is typically valid over moderate ranges in capacity; the validity over larger ranges is undetermined. The impact of any error resulting from utilizing this ratio beyond its valid range is considered to be within the range of accuracy of the estimate.

Pumping-Generating Plant Costs

The pumping-generating plant cost estimates are based on actual construction costs for the Waddell Pumping-Generating Plant in Arizona, which was completed in 1994 and is similar in size and scope

to the generating facilities. To develop a cost for pumping-generating facilities, the actual construction cost of the Waddell Pumping-Generating Plant (escalated to October 1996 dollars) was factored by the following empirical equation:

$$\frac{(Cost)_1}{(Cost)_2} = \frac{HP_1^{6/10}}{HP_2^{6/10}}$$

Where HP is equal to horsepower.

This cost factor formula is typically valid over moderate ranges in horsepower; the validity over larger ranges is undetermined. The impact of any error resulting from utilizing this ratio beyond its valid range is also expected to be within the range of the accuracy of the estimate.

Reservoir Clearing

The total area that needs to be cleared is assumed to be ten percent of the water surface area (based on the DWR report titled, *SWP Future Supply Program Thomes-Newville Plan*, September 1981). The reservoir clearing areas needed would be 1,390 and 1,670 acres for the 1.84 maf and 3.08 maf alternatives, respectively.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by engineering judgment based on a similar level of cost estimation. Contingencies

were chosen to be 20 percent, and engineering, construction management, and administration were chosen to be 35 percent. A cost range was developed for the project by subtracting 10 percent from the estimated capital cost for the low end cost and adding 15 percent to the estimated capital cost for the high end.

PRELIMINARY COST FINDINGS

The total estimated cost associated with constructing the Thomes-Newville Reservoir Project as it has been described within this evaluation ranges from \$1,540 to \$1,970 million and \$1,590 to \$2,030 million for a project with 1.84 and 3.08 maf of storage at Newville Reservoir, respectively.

The difference in cost of the two alternatives is attributed exclusively to the difference in Newville Reservoir storage capacity. The 1.84 maf Newville Reservoir has a total estimated cost of \$418 million, with \$217 million attributable to the Newville Pumping-Generating Plant. The 3.08 maf Newville Reservoir has a total estimated cost of \$556 million, with \$250 million attributable to the Newville Pumping-Generating Plant.

The costs of the remaining facilities (Thomes Diversion Facility, Tehenn Reservoir, Tehenn Pumping-Generating Plant, Tehenn Canal, Black Butte Pumping-Generating Plant, Black Butte Canal, Sour Grass Pumping-Generating Plant, and the Sour Grass Canal) are the same for both alternatives. The costs and configuration of the above facilities are based on a conveyance capacity of 5,000 cfs from the Tehama-Colusa Canal to Newville Reservoir and on a conveyance capacity of 10,000 cfs from the Thomes Creek Diversion Facility to Newville Reservoir. The total estimated costs of these facilities is about \$642 million. Contingencies and engineering, administrative, and legal services make up the remaining cost of constructing these projects.

ENVIRONMENTAL CONSIDERATIONS

[NOTE: The Environmental Considerations section of this report needs to be reevaluated by DWR to ensure consistency with the information in the previous sections.]

This portion of the report provides a summary of environmental considerations related to the proposal for developing a Thomes-Newville Reservoir Project. This section describes the fish, wildlife, plant, and cultural resources that could be affected, and identifies, where possible, the extent of the effect of the proposal on these resources. For the most part, the information presented in this section was gathered from existing literature, with limited original research. No field work was conducted for this analysis.

WILDLIFE

Depending on the reservoir configuration selected, the project could inundate up to 13,900 acres of terrestrial wildlife habitat, and up to 35 miles of perennial stream habitat.

One of the more significant results of constructing this complex would be the loss of over 2,000 acres of critical winter range for an estimated 1,100 deer of the Thomes Creek (Lake Hollow) herd and the displacement of over 600 migratory and resident deer. Potential impacts to steelhead and salmon may also result from the loss of a portion of their periodic run. The impact of run blockage for Sacramento squawfish and suckers, is expected to be significant. Indirect fish losses can be expected at the project's Sacramento River diversion.

Fish, Amphibians, Reptiles, and Invertebrates

Aquatic habitat in the project area include perennial pools and seasonally flowing streams, with some cooler streams from the mountains. The streams and numerous tributaries within the

potential inundation zone provide habitat for a number of cold- and warm-water fish species.

Fish habitat zones within the project area include the Rainbow Trout, California Roach, and Squawfish-Sucker-Hardhead zones. Representative species that are supported by these zones include rainbow trout, brown trout, Chinook salmon, smallmouth bass, green sunfish, redear sunfish, channel catfish, white catfish, brown bullhead, black bullhead, threespine stickleback, pacific lamprey, hard head, Sacramento squawfish, Sacramento sucker, hitch, golden shinner, mosquitofish, and prickly sculpin. The principal gamefish are trout and bass. Small numbers of Chinook salmon and steelhead enter Stony Creek and Thomes Creek during the fall and winter.

The project could result in creek flow reductions which would limit spawning and rearing habitat for a small populations of Chinook salmon and steelhead trout. Flow reductions in Thomes Creek may also limit spawning and rearing opportunities for non-game species such as Sacramento squawfish and Sacramento suckers. The latter impact is expected to be greater because of the much larger size of the squawfish and sucker runs. Altered stream flows could cause the composition in some the areas creeks to change. In some cases, stabilized water levels in the new reservoirs will have a beneficial effect on warm water fish species such as striped bass.

In addition, indirect effects on fish in the Sacramento River and Delta could occur as a result of stoppage of gravel recruitment causing eventual degradation of additional spawning, incubation, and rearing habitat. Other effects include reduced insect production due to increased current velocities over rifle areas, increased backwater fish production due to higher flows, increased estuarine productivity due to higher flows which would transport more nutrients and detritus, a possible increase in aquatic organism survival due to the dilution of toxicant caused by higher flows, possible changes in the timing and location of striped bass spawning due to streamflow alterations, possible improvement of American shad survival due to higher flows, increased salmon mortalities at alternative Sacramento River pump diversions, and unknown estuary changes in the Delta due to reductions in uncontrolled flows.

The Thomes-Newville Reservoir Project supports 12 different species of amphibians and over 20 species of reptiles.

General Wildlife

Lands within the Thomes-Newville Reservoir Project area support diverse wildlife. The primary game species include black-tailed deer, California quail, mourning dove, wild turkey, and furbearers. Non-game species include numerous species of songbirds and mammals. The grasslands within the project area provide valuable foraging opportunities for raptors such as golden eagles and prairie falcons. Previous surveys have identified up to 145 species of birds in four different habitat types within the project area.

The project would provide benefits to water-associated birds by increasing available habitat.

Significant numbers of wintering deer migrate through sections of the project area and use the area as wintering habitat. About 19 percent of the current winter range of the Thomes Creek (Lake Hollow) deer herd would be inundated by the proposed facilities. It may be possible to lessen this impact by improving habitats in the Thomes Creek drainage upstream of the proposed Newville reservoir.

Sensitive and Listed Fish and Wildlife Species

Several State or federally listed fish species are known to exist within the area of the proposed Thomes-Newville Reservoir Project. According to the California Department of Fish and Game's (CDFG) Natural Diversity Data Base (Version 8/96), there are two wildlife species that are State or federally listed, and two wildlife species that are either candidates for listing, and/or species designated by CDFG as "species of special concern."

Listed wildlife species that have been known to occur in or near the area affected by the proposed complex include bald eagle (Federal Threatened/State Endangered), and northern spotted owl (Federal Threatened). Other listed species that may be found in the project area include bank swallow, willow flycatcher, and Swainson's hawk.

Wildlife species that are either candidates for state or federal listing, or considered "species of special concern" by the CDFG that could be affected by the proposed project include northern goshawk tailed frog (Federal Candidate/CDFG Species of Special Concern), and prairie falcon (CDFG Species of Special Concern). Other CDFG Species of Special Concern that may be found using the project area include golden eagle, osprey, Coopers hawk, yellow warbler, and tricolored blackbird.

Wintering southern bald eagles currently use the riparian areas within the project complex for roosting. Reductions in riparian habitat will reduce roosting habitat for eagles and a reduction of squawfish and suckers would reduce forage opportunities for eagles. Maintenance of riparian habitat below project diversions and sustained fish populations in the new reservoirs could lessen the impact of the project on these wintering eagles. Golden eagles, most abundant during the winter, can be found using the project area year-round.

Bank swallows are summer visitors to the project area. Nesting colonies have been known to occur in the past along Thomes Creek.

VEGETATION

Vegetation at the Thomes-Newville Reservoir Project consists primarily of grasslands, oak-pine woodland, and chaparral. Riparian vegetation occurs along the numerous rivers and streams in the area. Vernal pools have been scattered throughout the project area in the past.

Sensitive and Listed Plant Species

One listed plant species, Indian valley brodiaea (Federal Candidate, State Endangered), is known to occur within the area proposed for the Thomes-Newville Reservoir. Other sensitive plant species or plants that are candidates for federal or state listing, could possibly be found in the project area. These species include drymaria-like western flax, Tehama County western flax, Brandegee's eriastrum, adobe lily, Ahart's paronychia, Shasta clarkia, and Butte County fritillary.

Two additional plants, diamorphic snapdragon and dwarf soaproot, listed by the California Native Plant Society as being rare, threatened or endangered in California and elsewhere, could also be affected by the proposed project.

There are two special status habitats in the area affected by the proposed project: Great Valley cottonwood riparian forest, and northern interior cypress forest.

Wetlands

Based on wetland information from USFWS's National Wetlands Inventory Maps, the following lands would be directly affected by the project: 36 miles of intermittent streambeds; 35 miles of perennial streams, 10 miles of emergent seasonally flooded wetlands (shallow marsh), one mile of emergent temporarily flooded wetlands (wet meadow), one mile of shrub-scrub wetlands, one mile of forested wetlands, one mile of forested/scrub-shrub wetland, 71 acres of open water, artificially flooded wetlands, 25 acres of forested wetland (wet meadow), seven acres of shrub-scrub (wet meadow), four acres of emergent shallow marsh, and 45 acres of ponds.

CULTURAL RESOURCES

There are 188 non-significant and an estimated 35 significant prehistoric sites in the proposed project's area. There is also an estimate of 50 non-significant, 20 significant historic sites, and 35 ethnographic sites.

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Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
THOMES-NEWVILLE RESERVOIR PROJECT

| | 1.84 MAF | 3.08 MAF |
|--|-------------------------------|-----------------|
| Newville Reservoir | | |
| Normal Pool Elevation (feet above MSL) | 900 | 980 |
| Capacity at Normal Pool Elevation (MAF) | 1.84 | 3.08 |
| Inundation Area (acres) | 13,900 | 16,700 |
| Main Dam | | |
| Type | Zoned Earthfill | Zoned Earthfill |
| Height above Streambed (feet) | 320 | 400 |
| Top of Dam (feet above MSL) | 920 | 1,000 |
| Embankment Volume (million cubic yards) | 16,000,000 | 25,000,000 |
| Freeboard (feet) | 20 | 20 |
| Downstream Face Slope (horizontal on vertical) | 2.5:1 | 2.5:1 |
| Upstream Face Slope (horizontal on vertical) | 3.25:1 | 3.25:1 |
| Crest Length (feet) | 2,400 | 3,200 |
| Spillway Capacity (cfs) | 35,700 | 35,700 |
| Emergency Spillway (cfs) | 8,000 | 8,000 |
| Inlet/Outlet Capacity (cfs) | 5,000 | 5,000 |
| Saddle Dams | | |
| Number Required | 1 | 10 |
| Embankment Volume (cubic yards) | 197,000 | 4,700,000 |
| Thomes Creek Diversion Structure | | |
| Dam Type | Conventional Concrete Gravity | |
| Top of Dam (feet above MSL) | 1,050 | 1,050 |
| Overflow Section Width (feet) | 500 | 500 |
| Overflow Section Elevation (feet above MSL) | 1,035 | 1,035 |
| Gated Spillway Capacity (cfs) | 41,000 | 41,000 |
| Conveyance Canal Length (feet) | 13,100 | 13,100 |
| Conveyance Canal Capacity (cfs) | 10,000 | 10,000 |
| Concrete Chute Length (feet) | 2,150 | 0 |
| Tehenn Reservoir | | |
| Normal Pool Elevation (feet above MSL) | 610 | 610 |
| Capacity at Normal Pool Elevation (acre-feet) | 32,500 | 32,500 |
| Tehenn Dam | | |
| Type | Earthfill | Earthfill |
| Embankment Volume (cubic yards) | 2,600,000 | 2,600,000 |
| Height Above Streambed (feet) | 112 | 112 |
| Crest Length (feet) | 2,500 | 2,500 |
| Spillway Capacity (cfs) | 50,000 | 50,000 |
| Outlet Works Capacity (cfs) | 5,000 | 5,000 |
| Tehenn Canal | | |
| Invert Elevation (feet above MSL) | 410 | 410 |
| Capacity (cfs) | 5,000 | 5,000 |
| Length (MI) | 5.0 | 5.0 |

Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
THOMES-NEWVILLE RESERVOIR PROJECT

| | 1.84 MAF | 3.08 MAF |
|---|----------|----------|
| Pumping Plants | | |
| Capacity (cfs) | | |
| Newville | 5,000 | 5,000 |
| Tehenn | 5,000 | 5,000 |
| Black Butte | 5,000 | 5,000 |
| Sour Grass | 5,000 | 5,000 |
| TDM (feet) | | |
| Newville | 300 | 380 |
| Tehenn | 190 | 190 |
| Black Butte | 144 | 144 |
| Sour Grass | 115 | 115 |
| HP | | |
| Newville | 226,912 | 287,422 |
| Tehenn | 143,711 | 143,711 |
| Black Butte | 108,918 | 108,918 |
| Sour Grass | 86,983 | 86,983 |
| Black Butte Canal | | |
| Invert Elevation | 310 | 310 |
| Capacity (cfs) | 5,000 | 5,000 |
| Length (mile) | 4.5 | 4.5 |
| Sour Grass Canal | | |
| Invert Elevation | 205 | 205 |
| Capacity (cfs) | 5,000 | 5,000 |
| Length (mile) | 4.5 | 4.5 |
| Black Butte Reservoir (Existing) | | |
| Normal Pool Elevation (feet above MSL) | 474 | 474 |
| Capacity at Normal Pool Elevation (acre-feet) | 392,000 | 392,000 |

Table 2a
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|---------------------------------------|-----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| I. LANDS | | | | | | | | |
| Newville Reservoir Right of Way | 18,350 | AC | | | | \$1,500 | \$27,525,000 | 5 |
| Thomes Creek Diversion Right of Way | 125 | AC | | | | \$1,500 | \$187,500 | 5 |
| Tehenn Reservoir right of Way | 1,250 | AC | | | | \$1,500 | \$1,875,000 | 5 |
| Tehenn Canal Right of Way | 212 | AC | | | | \$1,500 | \$318,000 | 5 |
| Black Butte Canal Right of Way | 191 | AC | | | | \$1,500 | \$286,500 | 5 |
| Sour Grass Canal Right of Way | 191 | AC | | | | \$1,500 | \$286,500 | 5 |
| SUBTOTAL LANDS | | | | | | | \$30,478,500 | |
| II. DAM | | | | | | | | |
| Mobilization | JOB | LS | 132 | 159 | \$2,300,000 | \$2,770,455 | \$2,770,455 | 1, page 39 |
| Care of Water | JOB | LS | 132 | 159 | \$150,000 | \$180,682 | \$180,682 | 1, page 39 |
| Foundation Excavation and Stripping | 1,946,670 | CY | | | | \$3.23 | \$6,287,744 | 2, item I-d |
| Imported Borrow - Impervious | 4,301,200 | CY | | | | \$3.22 | \$13,849,864 | 2, item I-e |
| Place and Compact Impervious Material | 3,910,200 | CY | | | | \$0.95 | \$3,714,690 | 2, item I-f |
| Furnish and Compact Filter and Drain | 1,595,300 | CY | | | | \$8.54 | \$13,623,862 | 2, item I-i & j |
| Furnish and Compact Random Material | 1,677,800 | CY | | | | \$3.11 | \$5,217,958 | 2, item I-l |
| Furnish and Compact Sand and Gravel | 8,816,930 | CY | | | | \$5.90 | \$52,019,887 | 2, item I- g&h |
| Drill Grout Holes | 35,300 | LF | | | | \$18.70 | \$660,110 | 2, item I-q |
| Grout Connections | 380 | EA | 132 | 159 | \$50.00 | \$60.00 | \$22,800 | 1, page 39 |
| Grouting | 870 | CY | 132 | 159 | \$190.00 | \$229 | \$199,230 | 1, page 39 |
| Grout Pipe | 1,140 | LF | 132 | 159 | \$8.00 | \$10.00 | \$11,400 | 1, page 39 |
| Instrumentation | JOB | LS | 132 | 159 | \$350,000 | \$421,591 | \$421,591 | 1, page 39 |
| SUBTOTAL DAM | | | | | | | \$98,980,273 | |
| III. OUTLET WORKS | | | | | | | | |
| Dewatering | JOB | LS | 141 | 206 | \$100,000 | \$146,099 | \$146,099 | 1, page 42 |
| Excavations for: | | | | | | | | |
| Gate Chamber | 1,500 | CY | 141 | 206 | \$100 | \$146 | \$219,000 | 1, page 42 |
| Intake and Gate Chamber | 12,000 | CY | | | | \$6.76 | \$81,120 | 2, item VI - I |
| Penstocks and Tunnel | 37,000 | CY | | | | \$128.27 | \$4,745,990 | 2, item VI - s |
| Portal | 127,000 | CY | 141 | 206 | \$6.00 | \$9.00 | \$1,143,000 | 1, page 42 |
| By-pass and Trifuration | 9,000 | CY | 141 | 206 | \$4.00 | \$6.00 | \$54,000 | 1, page 42 |
| Shaft | 1,000 | CY | | | | \$147 | \$146,590 | 2, item II - c |
| Diversion Channel | 71,000 | CY | 141 | 206 | \$4.00 | \$6.00 | \$426,000 | 1, page 42 |
| Compaction Backfill | 7,000 | CY | 141 | 206 | \$20.00 | \$29.00 | \$203,000 | 1, page 42 |

Table 2a
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|---------------------------------------|-----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| Granular Structural Backfill | 2,000 | CY | | | | \$18.99 | \$37,980 | 2, item VI - h |
| Concrete | | | | | | | | |
| Penstock-Tunnel | 10,500 | CY | | | | \$321 | \$3,367,140 | 2, item VI - t |
| Intake and Gate Chamber Access Tunnel | 3,600 | CY | | | | \$321 | \$1,154,448 | 2, item VI - t |
| Gate Chambers | 700 | CY | | | | \$340 | \$237,650 | 2, item VI - k |
| Low Intake | 500 | CY | | | | \$340 | \$169,750 | 2, item VI - k |
| Low Intake Foundation | 400 | CY | | | | \$270 | \$108,180 | 2, item VI - j |
| Control Valve House | 700 | CY | | | | \$340 | \$237,650 | 2, item VI - k |
| Vertical Shaft | 300 | CY | | | | \$340 | \$101,850 | 2, item VI - k |
| Grouting Cement | 21,000 | BBL | 141 | 206 | \$18.00 | \$26.00 | \$546,000 | 1, page 42 |
| Mass Concrete | 4,000 | CY | | | | \$293 | \$1,172,360 | 2, item III - d |
| Ring Girder | 72,000 | LBS | 141 | 206 | \$2.00 | \$3.00 | \$216,000 | 1, page 42 |
| Overhead Hoist Rails | 150,000 | LBS | | | | \$3.63 | \$544,500 | 2, item VI - p |
| 2 1/2 " x 2 1/2 " x 1/4 " Angles | 27,000 | LBS | | | | \$3.63 | \$98,010 | 2, item VI-m |
| 1 1/2 " x 30 " x 20 " Bearing Plate | 30,000 | LBS | | | | \$3.63 | \$108,900 | 2, item VI-m |
| Walkway Plate | 54,000 | LBS | | | | \$3.63 | \$196,020 | 2, item VI-m |
| Gantry Crane (20 ton) | 1 | EA | 141 | 206 | \$195,000 | \$284,894 | \$284,894 | 1, page 41 |
| Trashrack 6' x 18' | 6 | EA | 141 | 206 | \$10,000 | \$14,610 | \$87,660 | 2, item VI-q |
| 60 " Dia. Gate Valve | 12 | EA | 141 | 206 | \$77,000 | \$112,496 | \$1,349,952 | 1, page 41 |
| 84 " Dia. Howell Bungler Valve | 2 | EA | 141 | 206 | \$300,000 | \$438,298 | \$876,596 | 1, page 41 |
| 84 " Dia. Gate Valve | 2 | EA | 141 | 206 | \$310,000 | \$452,908 | \$905,816 | 1, page 41 |
| 90 " Dia Gate Valve | 1 | EA | 141 | 206 | \$350,000 | \$511,348 | \$511,348 | 1, page 41 |
| Valve Thimbles | 12 | EA | 141 | 206 | \$15,000 | \$21,915 | \$262,980 | 1, page 41 |
| Valve Operator | 12 | EA | 141 | 206 | \$20,000 | \$29,220 | \$350,640 | 1, page 41 |
| 120 " Dia. Steel Penstock | 1,050,000 | LBS | | | | \$1.65 | \$1,732,500 | 2, item VII-c |
| 90 " Dia. Steel By-pass | 200,000 | LBS | | | | \$1.65 | \$330,000 | 2, item VII-c |
| 72 " Dia. Steel By-pass | 50,000 | LBS | | | | \$1.65 | \$82,500 | 2, item VII-c |
| 60 " Dia. Steel By-pass | 97,000 | LBS | | | | \$1.65 | \$160,050 | 2, item VII-c |
| Grouting Pipe | 13,630 | LBS | 132 | 159 | \$8.00 | \$10.00 | \$136,300 | 1, page 41 |
| Bifurcation 10' to 8' | 2 | EA | 141 | 206 | \$17,000 | \$24,837 | \$49,674 | 1, page 41 |
| Reducer 10' to 6' | 1 | EA | 141 | 206 | \$10,000 | \$14,610 | \$14,610 | 1, page 41 |
| Bifurcation 10' to 5' | 2 | EA | 141 | 206 | \$14,000 | \$20,454 | \$40,908 | 1, page 41 |
| Timber for Tunnel Supports | 300 | MBF | | | | \$1,930 | \$579,000 | 2, item VI - w |
| Grout Drilling Holes | 18,500 | LF | | | | \$17.70 | \$327,450 | 2, item I - g |
| Standby Generator | 1 | EA | 141 | 206 | \$45,000 | \$65,745 | \$65,745 | 1, page 41 |
| Architectural Features | JOB | LS | 141 | 206 | \$300,000 | \$438,298 | \$438,298 | 1, page 41 |

Table 2a
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

| DESCRIPTION | QUANTITY | UNIT ^a | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|--|----------|-------------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-----------------------|
| Cathodic Protection | JOB | LS | 141 | 206 | \$35,000 | \$51,135 | \$51,135 | 1, page 41 |
| Protective Coatings | JOB | LS | 141 | 206 | \$100,000 | \$146,099 | \$146,099 | 1, page 41 |
| SUBTOTAL | | | | | | | \$24,245,392 | |
| Increase Capacity from 1,500 cfs to 5,000 cfs, factor cost by $(5,000/1,500)^{3/8} = 1.57$ | | | | | | | | |
| SUBTOTAL OUTLET WORKS | | | | | | | \$38,065,265 | |
| IV. SPILLWAY | | | | | | | | |
| Mobilization | JOB | LS | 143 | 186 | \$300,000 | \$390,210 | \$390,210 | 1, page 44 |
| Drill Grout Holes | 920 | LF | | | | \$18.70 | \$17,204 | 2, item I-g |
| Grout Connections | 15 | EA | 143 | 186 | \$25.00 | \$33.00 | \$495 | 1, page 44 |
| Grouting | 23 | CY | 143 | 186 | \$280 | \$364 | \$8,372 | 1, page 44 |
| Grout Pipe | 68 | LF | 132 | 159 | \$8.00 | \$10.00 | \$680 | 1, page 44 |
| Excavation (blasting) | 725,000 | CY | | | | \$7.66 | \$5,553,500 | 2, item V-b3 |
| Excavation | 249,000 | CY | | | | \$4.03 | \$1,003,470 | 2, av. item IIa, IIIa |
| Rock Riprap | 2,000 | CY | | | | \$31.64 | \$63,280 | 2, item I-n |
| Granular Backfill | 5,800 | CY | | | | \$45.09 | \$261,522 | 2, item II-n |
| Structural Backfill | 8,100 | CY | 143 | 186 | \$20.00 | \$26.00 | \$210,600 | 1, page 44 |
| Compacted Backfill | 44,700 | CY | | | | \$8.17 | \$365,199 | 2, item III-f |
| Aggregate Base | 480 | TON | | | | \$19.15 | \$9,192 | 2, item V-d |
| Asphalt Concrete | 400 | TON | | | | \$58.92 | \$23,568 | 2, item V-e |
| Mass Concrete | 6,200 | CY | | | | \$293 | \$1,817,158 | 2, item III-d |
| Structural Concrete | 20,700 | CY | | | | \$401 | \$8,307,117 | 2, av. item IIh, IIIc |
| Embedded Metal | JOB | LS | 143 | 186 | \$35,000 | \$45,524 | \$45,524 | 1, page 44 |
| Misc. Metal | JOB | LS | 143 | 186 | \$50,000 | \$65,035 | \$65,035 | 1, page 44 |
| Radial Gate (20' x 30') | 2 | EA | 143 | 186 | \$270,000 | \$351,189 | \$702,378 | 1, page 44 |
| Radial Gate Hoist Assembly | 2 | EA | 143 | 186 | \$90,000 | \$117,063 | \$234,126 | 1, page 44 |
| Stop Log (6' x 21') | 12 | EA | 143 | 186 | \$14,000 | \$18,210 | \$218,520 | 1, page 44 |
| Stop Log Storage Rack | JOB | LS | 143 | 186 | \$20,000 | \$26,014 | \$26,014 | 1, page 44 |
| Stop Log Lifting Beam | JOB | LS | 143 | 186 | \$5,000 | \$6,503 | \$6,503 | 1, page 44 |
| Electrical Work | JOB | LS | 143 | 186 | \$30,000 | \$39,021 | \$39,021 | 1, page 44 |
| Control Building (12' x 16') | JOB | LS | 143 | 186 | \$26,000 | \$33,818 | \$33,818 | 1, page 44 |
| Standby Generator | JOB | LS | 143 | 186 | \$40,000 | \$52,028 | \$52,028 | 1, page 44 |
| SUBTOTAL SPILLWAY | | | | | | | \$19,454,334 | |
| V. RESERVOIR | | | | | | | | |
| Reservoir Clearing (Newville and Tehenn) | 1,515 | AC | | | | \$1,097 | \$1,661,955 | 2, item IV-a |

Table 2a
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|------------------------------------|-----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| Improvements | JOB | LS | 137 | 176 | \$30,000 | \$38,540 | \$38,540 | 1, page 47 |
| Construction Facilities | JOB | LS | 137 | 176 | \$20,000 | \$25,693 | \$25,693 | 1, page 47 |
| Excavate Overlook | 48,400 | CY | 137 | 176 | \$14.00 | \$18.00 | \$871,200 | 1, page 47 |
| Aggregate Base for Overlook | 2,000 | TON | | | | \$19.15 | \$38,300 | 2, item V-d |
| Asphalt Concrete for Overlook | 511 | TON | | | | \$58.92 | \$30,108 | 2, item v-e |
| Liquid Asphalt Prime and Seal | 85 | TON | | | | \$324.03 | \$27,543 | 2, av. item V-f&g |
| Landscaping Overlook | JOB | LS | 137 | 176 | \$24,000 | \$30,832 | \$30,832 | 1, page 47 |
| Visitor's Center | JOB | LS | 137 | 176 | \$200,000 | \$256,934 | \$256,934 | 1, page 47 |
| SUBTOTAL RESERVOIR | | | | | | | \$2,981,105 | |
| VI. OVERLOOK ACCESS ROAD | | | | | | | | |
| Excavation | 106,000 | CY | | | | \$3.98 | \$421,880 | 2, item V-b1 |
| Class II Aggregate Base | 5,710 | TON | | | | \$19.15 | \$109,347 | 2, item V-d |
| Asphalt Concrete | 941 | TON | | | | \$58.92 | \$55,444 | 2, item V-e |
| Liquid Asphalt Prime and Seal Coat | 157 | TON | | | | \$324 | \$50,873 | 2, av. item V-f&g |
| Guard Rail | 2,650 | LF | 160 | 237 | \$20.00 | \$30.00 | \$79,500 | 1, page 50 |
| 18 " CMP | 180 | LF | | | | \$44.78 | \$8,060 | 2, item V-j |
| 24 " CMP | 490 | LF | | | | \$53.53 | \$26,230 | 2, item V-k |
| 30 " CMP | 200 | LF | 160 | 237 | \$45.00 | \$67.00 | \$13,400 | 1, page 50 |
| Structure Excavation | 350 | CY | 160 | 237 | \$12.00 | \$18.00 | \$6,300 | 1, page 50 |
| Structure Backfill | 270 | CY | 160 | 237 | \$20.00 | \$30.00 | \$8,100 | 1, page 50 |
| SUBTOTAL OVERLOOK ACCESS ROAD | | | | | | | \$779,133 | |
| VII. ROAD RELOCATIONS | | | | | | | | |
| Newville to Paskenta | | | | | | | | |
| 48 " CSP | 140 | LF | 146 | 219 | \$60.00 | \$90.00 | \$12,600 | 1, page 51 |
| 26 " CSP | 240 | LF | 146 | 219 | \$40.00 | \$60.00 | \$14,400 | 1, page 51 |
| 24 " CSP | 160 | LF | 146 | 219 | \$30.00 | \$45.00 | \$7,200 | 1, page 51 |
| 18 " CSP | 570 | LF | 146 | 219 | \$25.00 | \$38.00 | \$21,660 | 1, page 51 |
| Structure Excavation | 4,700 | CY | 146 | 219 | \$25.00 | \$38.00 | \$178,600 | 1, page 51 |
| Structure Backfill | 4,400 | CY | 146 | 219 | \$45.00 | \$68.00 | \$299,200 | 1, page 51 |
| Roadway Excavation | 1,033,000 | CY | | | | \$3.98 | \$4,111,340 | 2, item V-b1 |
| Aggregate Base | 31,000 | TON | | | | \$19.15 | \$593,650 | 2, item V-d |
| Asphalt Concrete | 15,000 | TON | | | | \$58.92 | \$883,800 | 2, item V-e |
| Down Drains | 24 | EA | 146 | 219 | \$1,000 | \$1,500 | \$36,000 | 1, page 51 |
| Fence | 66,800 | LF | 146 | 219 | \$2.00 | \$3.00 | \$200,400 | 1, page 51 |

Table 2a
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|-------------------------------------|----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| SUBTOTAL NEWVILLE TO PASKENTA ROAD | | | | | | | \$6,358,850 | |
| Cattle Crossings (6 total) | | | | | | | | |
| 11' - 5" x 73" Multiple Steel Pipe | 432 | LF | 146 | 219 | \$180 | \$270 | \$116,640 | 1, page 51 |
| Structure Excavation | 1,710 | CY | 146 | 219 | \$25.00 | \$38.00 | \$64,980 | 1, page 51 |
| Structure Backfill | 1,100 | CY | 146 | 219 | \$45.00 | \$68.00 | \$74,800 | 1, page 51 |
| SUBTOTAL CATTLE CROSSINGS | | | | | | | \$256,420 | |
| Round Valley Road | | | | | | | | |
| 48" CSP | 300 | LF | 146 | 219 | \$60.00 | \$90.00 | \$27,000 | 1, page 51 |
| 24" CSP | 2,120 | LF | 146 | 219 | \$30.00 | \$45.00 | \$95,400 | 1, page 51 |
| Roadway Excavation | 233,000 | CY | 146 | 219 | | \$3.98 | \$927,340 | 2, item V-b1 |
| Structure Excavation | 2,000 | CY | 146 | 219 | \$25.00 | \$38.00 | \$76,000 | 1, page 51 |
| Structure Backfill | 1,600 | CY | 146 | 219 | \$45.00 | \$68.00 | \$108,800 | 1, page 51 |
| Aggregate Base | 9,100 | TON | | | | \$19.15 | \$174,265 | 2, item V-d |
| Asphalt Concrete | 4,400 | TON | | | | \$58.92 | \$259,248 | 2, item V-e |
| Down Drains | 12 | EA | 146 | 219 | \$1,000 | \$1,500 | \$18,000 | 1, page 51 |
| Fence | 20,000 | LF | 146 | 219 | \$2.00 | \$3.00 | \$60,000 | 1, page 51 |
| Compacted Embankment and Overhaul | 211,000 | CY | | | | \$1.36 | \$286,960 | 2, item V-c1 |
| Bridge D/S of Newville Spillway | 6,800 | SF | | | | \$100 | \$680,000 | 3 |
| SUBTOTAL ROUND VALLEY ROAD | | | | | | | \$2,713,013 | |
| Chrome to Burrows Gap Road | | | | | | | | |
| 60" CSP | 250 | LF | 146 | 219 | \$70.00 | \$105 | \$26,250 | 1, page 52 |
| 24" CSP | 920 | LF | 146 | 219 | \$30.00 | \$45.00 | \$41,400 | 1, page 52 |
| Roadway Excavation | 202,000 | CY | | | | \$3.98 | \$803,960 | 2, item V-b1 |
| Structure Excavation | 1,600 | CY | 146 | 219 | \$25.00 | \$38.00 | \$60,800 | 1, page 52 |
| Structure Backfill | 1,800 | CY | 146 | 219 | \$45.00 | \$68.00 | \$122,400 | 1, page 52 |
| Aggregate Base | 9,100 | TON | | | | \$19.15 | \$174,265 | 2, item V-d |
| Asphalt Concrete | 5,300 | TON | | | | \$58.92 | \$312,276 | 2, item V-e |
| Fence | 53,000 | LF | 146 | 219 | \$2.00 | \$3.00 | \$159,000 | 1, page 52 |
| Bridge over Stony Creek Diversion | 6,800 | SF | | | | \$100 | \$680,000 | 3 |
| SUBTOTAL CHROME TO BURROWS GAP ROAD | | | | | | | \$2,380,351 | |
| SUBTOTAL ROAD RELOCATIONS | | | | | | | \$11,708,634 | |

Table 2a
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|---------------------------------------|----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| VIII. BURROWS GAP SADDLE DAM | | | | | | | | |
| Mobilization | JOB | LS | 132 | 159 | \$86,000 | \$103,591 | \$103,591 | 1, page 54 |
| Clear and Grub | 3 | AC | 132 | 159 | \$4,000 | \$4,818 | \$14,454 | 1, page 54 |
| Foundation Excavation | 87,400 | CY | | | | \$3.23 | \$282,302 | 2, item I-d |
| Drill Grout Holes | 2,700 | LF | | | | \$18.70 | \$50,490 | 2, item I-g |
| Grout Connections | 50 | EA | 132 | 159 | \$50.00 | \$60.00 | \$3,000 | |
| Grouting | 67 | CY | 132 | 159 | \$280 | \$337 | \$22,579 | |
| Grout Pipe | 225 | LF | 132 | 159 | \$8.00 | \$10.00 | \$2,250 | |
| Borrow - Impervious Material | 176,500 | CY | | | | \$3.22 | \$568,330 | 2, item I-e |
| Filter and Drain Material | 26,600 | CY | | | | \$8.54 | \$227,164 | 2, item I-i&j |
| Riprap | 6,640 | CY | | | | \$31.64 | \$210,090 | 2, item I-n |
| Riprap Bedding | 3,320 | CY | | | | \$1.79 | \$5,943 | 2, item I-m |
| Placed Impervious | 160,500 | CY | | | | \$0.95 | \$152,475 | 2, item I-f |
| Instrumentation | JOB | LS | 132 | 176 | \$50,000 | \$66,667 | \$66,667 | 1, page 54 |
| SUBTOTAL CONVEYANCE FACILITIES | | | | | | | \$1,709,334 | |

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX OCT. 79 | USBR INDEX OCT. 96 | UNIT COST OCT. 79 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|---|----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| IX. THOMES CREEK DIVERSION FACILITIES | | | | | | | | |
| Diversion Structure | JOB | LS | 121 | 207 | \$7,940,000 | \$13,583,306 | \$13,583,306 | 4, page 4-13 |
| Intake Structure | JOB | LS | 122 | 213 | \$1,150,000 | \$2,007,787 | \$2,007,787 | 4, page 4-13 |
| Canal and Roads | JOB | LS | 120 | 199 | \$21,740,000 | \$36,052,167 | \$36,052,167 | 4, page 4-13 |
| Outlet Chute | JOB | LS | 122 | 213 | \$1,860,000 | \$3,247,377 | \$3,247,377 | 4, page 4-13 |
| SUBTOTAL THOMES CREEK DIVERSION FACILITIES | | | | | | | \$54,890,637 | |

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX APR. 80 | USBR INDEX OCT. 96 | UNIT COST APR. 80 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|---------------------------------|----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| X. CONVEYANCE FACILITIES | | | | | | | | |
| Tehama Colusa Canal Turnout | JOB | LS | | | | \$1,543,000 | \$1,543,000 | 3 |
| Sour Grass Canal | JOB | LS | 127 | 199 | \$13,220,222 | \$20,715,151 | \$20,715,151 | 4- page 9-17 |

Table 2a
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX APR. 80 | USBR INDEX OCT. 96 | UNIT COST APR. 80 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|--|----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| Sour Grass Pumping-Generating Plant | | | | | | | | |
| Q=5,000 cfs, TDH = 115 ft., HP = 86,983 | JOB | LS | | | | \$121,911,000 | \$121,911,000 | 3 |
| Black Butte Canal, factored by (5,000/10,000) ^{3/8} | JOB | LS | 127 | 199 | \$15,453,000 | \$24,213,756 | \$24,213,756 | 4- page 9-17 |
| Black Butte Pumping-Generating Plant | | | | | | | | |
| Q=5,000 cfs, TDH = 144 ft., HP = 108,918 | JOB | LS | | | | \$139,522,000 | \$139,522,000 | 3 |
| Tehenn Canal, factored by 5,000/3,000) ^{3/8} | JOB | LS | 127 | 199 | \$47,658,000 | \$74,676,709 | \$74,676,709 | 4- page 5-19 |
| Tehenn Reservoir | JOB | LS | 127 | 176 | \$29,010,000 | \$40,202,835 | \$40,202,835 | 4- page 5-19 |
| Tehenn Pumping-Generating Plant | | | | | | | | |
| Q=5,000 cfs, TDH = 190 ft., HP = 143,711 | JOB | LS | | | | \$164,770,000 | \$164,770,000 | 3 |
| Newville Pumping-Generating Plant | | | | | | | | |
| Q=5,000 cfs, TDH = 300 ft., HP = 226,912 | JOB | LS | | | | \$216,720,000 | \$216,720,000 | 3 |
| SUBTOTAL CONVEYANCE FACILITIES | | | | | | | \$804,274,451 | |
| | | | | | | | | |
| SUB TOTAL FOR THOMES-NEWVILLE | | | | | | | \$1,061,600,000 | |
| CONTINGENCIES @ 20% | | | | | | | \$212,300,000 | |
| ESTIMATED CONSTRUCTION COST | | | | | | | \$1,273,900,000 | |
| ENG., LEGAL, AND ADM. @ 35% | | | | | | | \$445,900,000 | |
| ESTIMATED CAPITAL COST FOR THOMES-NEWVILLE | | | | | | | \$1,719,800,000 | |
| | | | | | | | | |
| ESTIMATED CAPITAL COST RANGE FOR THOMES-NEWVILLE | | | | | | | | |
| LOW (-10%) | | | | | | | \$1,548,000,000 | |
| HIGH (+15%) | | | | | | | \$1,978,000,000 | |
| | | | | | | | | |

Footnotes:

*CY=cubic yard; LB=pound; EA=each; LS=lump sum; LF=linear foot; SF=square foot; TON=ton; MI=mile; AC=acre

Cost Reference:

1. California Department of Water Resources, *SWP Future Supply Program, Thomes-Newville Plan*, September 1981.
2. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates*, December 1990.
3. Cost developed by Bookman-Edmonston Engineering.
4. California Department of Water Resources, *Thomes-Newville and Glenn Reservoir Plans - Engineering Feasibility*, November 1980.
5. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.

Table 2b
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

| DESCRIPTION | QUANTITY | UNIT ^a | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|---------------------------------------|------------|-------------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| I. LANDS | | | | | | | | |
| Newville Reservoir Right of Way | 22,060 | AC | | | | \$1,500 | \$33,090,000 | 5 |
| Thomes Creek Diversion Right of Way | 107 | AC | | | | \$1,500 | \$160,500 | 5 |
| Tehenn Reservoir Right of Way | 1,250 | AC | | | | \$1,500 | \$1,875,000 | 5 |
| Tehenn Canal Right of Way | 212 | AC | | | | \$1,500 | \$318,000 | 5 |
| Black Butte Canal Right of Way | 191 | AC | | | | \$1,500 | \$286,500 | 5 |
| Sour Grass Canal Right of Way | 191 | AC | | | | \$1,500 | \$286,500 | 5 |
| SUBTOTAL LANDS | | | | | | | \$36,816,500 | |
| II. DAM | | | | | | | | |
| Mobilization | JOB | LS | 132 | 159 | \$2,300,000 | \$2,770,455 | \$2,770,455 | 1, page 39 |
| Care of Water | JOB | LS | 132 | 159 | \$150,000 | \$180,682 | \$180,682 | 1, page 39 |
| Foundation Excavation and Stripping | 2,994,000 | CY | | | | \$3.23 | \$9,670,620 | 2, item I-d |
| Imported Borrow - Impervious | 6,615,300 | CY | | | | \$3.22 | \$21,301,266 | 2, item I-e |
| Place and Compact Impervious Material | 6,013,900 | CY | | | | \$0.95 | \$5,713,205 | 2, item I-f |
| Furnish and Compact Filter and Drain | 2,453,600 | CY | | | | \$8.54 | \$20,953,744 | 2, item I-i & j |
| Furnish and Compact Random Material | 2,580,500 | CY | | | | \$3.11 | \$8,025,355 | 2, item I-l |
| Furnish and Compact Sand and Gravel | 13,560,400 | CY | | | | \$5.90 | \$80,006,360 | 2, item I-g&h |
| Drill Grout Holes | 54,290 | LF | | | | \$18.70 | \$1,015,223 | 2, item I-q |
| Grout Connections | 585 | EA | 132 | 159 | \$50.00 | \$60.00 | \$35,100 | 1, page 39 |
| Grouting | 1,340 | CY | 132 | 159 | \$190.00 | \$229 | \$306,860 | 1, page 39 |
| Grout Pipe | 1,755 | LF | 132 | 159 | \$8.00 | \$10.00 | \$17,550 | 1, page 39 |
| Instrumentation | JOB | LS | 132 | 159 | \$350,000 | \$421,591 | \$421,591 | 1, page 39 |
| SUBTOTAL DAM | | | | | | | \$150,418,011 | |
| III. OUTLET WORKS | | | | | | | | |
| Dewatering | JOB | LS | 141 | 206 | \$100,000 | \$146,099 | \$146,099 | 1, page 42 |
| Excavations for: | | | | | | | | |
| Gate Chamber | 1,500 | CY | 141 | 206 | \$100 | \$146 | \$219,000 | 1, page 42 |
| Intake and Gate Chamber | 12,000 | CY | | | | \$6.76 | \$81,120 | 2, item VI - i |
| Penstocks and Tunnel | 37,000 | CY | | | | \$128.27 | \$4,745,990 | 2, item VI - s |
| Portal | 127,000 | CY | 141 | 206 | \$6.00 | \$9.00 | \$1,143,000 | 1, page 42 |
| By-pass and Trifurcation | 9,000 | CY | 141 | 206 | \$4.00 | \$6.00 | \$54,000 | 1, page 42 |
| Shaft | 1,000 | CY | | | | \$147 | \$146,590 | 2, item II - c |
| Diversion Channel | 71,000 | CY | 141 | 206 | \$4.00 | \$6.00 | \$426,000 | 1, page 42 |
| Compaction Backfill | 7,000 | CY | 141 | 206 | \$20.00 | \$29.00 | \$203,000 | 1, page 42 |
| Granular Structural Backfill | 2,000 | CY | | | | \$18.99 | \$37,980 | 2, item VI - h |
| Concrete | | | | | | | | |
| Penstock-Tunnel | 10,500 | CY | | | | \$321 | \$3,367,140 | 2, item VI - t |

Table 2b
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

| DESCRIPTION | QUANTITY | UNIT ^a | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|--|-----------|-------------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| Intake and Gate Chamber Access Tunnel | 3,600 | CY | | | | \$321 | \$1,154,448 | 2, item VI - t |
| Gate Chambers | 700 | CY | | | | \$340 | \$237,650 | 2, item VI - k |
| Low Intake | 500 | CY | | | | \$340 | \$169,750 | 2, item VI - k |
| Low Intake Foundation | 400 | CY | | | | \$270 | \$108,180 | 2, item VI - j |
| Control Valve House | 700 | CY | | | | \$340 | \$237,650 | 2, item VI - k |
| Vertical Shaft | 300 | CY | | | | \$340 | \$101,850 | 2, item VI - k |
| Grouting Cement | 21,000 | BBL | 141 | 206 | \$18.00 | \$26.00 | \$546,000 | 1, page 42 |
| Mass Concrete | 4,000 | CY | | | | \$293 | \$1,172,360 | 2, item III - d |
| Ring Girder | 72,000 | LBS | 141 | 206 | \$2.00 | \$3.00 | \$216,000 | 1, page 42 |
| Overhead Hoist Rails | 150,000 | LBS | | | | \$3.63 | \$544,500 | 2, item VI - p |
| 2 1/2 " x 2 1/2 " x 1/4 " Angles | 27,000 | LBS | | | | \$3.63 | \$98,010 | 2, item VI-m |
| 1 1/2 " x 30 " x 20 " Bearing Plate | 30,000 | LBS | | | | \$3.63 | \$108,900 | 2, item VI-m |
| Walkway Plate | 54,000 | LBS | | | | \$3.63 | \$196,020 | 2, item VI-m |
| Gantry Crane (20 ton) | 1 | EA | 141 | 206 | \$195,000 | \$284,894 | \$284,894 | 1, page 41 |
| Trashrack 6' x 18' | 6 | EA | 141 | 206 | \$10,000 | \$14,610 | \$87,660 | 2, item VI-q |
| 60 " Dia. Gate Valve | 12 | EA | 141 | 206 | \$77,000 | \$112,496 | \$1,349,952 | 1, page 41 |
| 84 " Dia. Howell Bungler Valve | 2 | EA | 141 | 206 | \$300,000 | \$438,298 | \$876,596 | 1, page 41 |
| 84 " Dia. Gate Valve | 2 | EA | 141 | 206 | \$310,000 | \$452,908 | \$905,816 | 1, page 41 |
| 90 " Dia Gate Valve | 1 | EA | 141 | 206 | \$350,000 | \$511,348 | \$511,348 | 1, page 41 |
| Valve Thimbles | 12 | EA | 141 | 206 | \$15,000 | \$21,915 | \$262,980 | 1, page 41 |
| Valve Operator | 12 | EA | 141 | 206 | \$20,000 | \$29,220 | \$350,640 | 1, page 41 |
| 120 " Dia. Steel Penstock | 1,050,000 | LBS | | | | \$1.65 | \$1,732,500 | 2, item VII-c |
| 90 " Dia. Steel By-pass | 200,000 | LBS | | | | \$1.65 | \$330,000 | 2, item VII-c |
| 72 " Dia. Steel By-pass | 50,000 | LBS | | | | \$1.65 | \$82,500 | 2, item VII-c |
| 60 " Dia. Steel By-pass | 97,000 | LBS | | | | \$1.65 | \$160,050 | 2, item VII-c |
| Grouting Pipe | 13,630 | LBS | 132 | 159 | \$8.00 | \$10.00 | \$136,300 | 1, page 41 |
| Bifurcation 10' to 8' | 2 | EA | 141 | 206 | \$17,000 | \$24,837 | \$49,674 | 1, page 41 |
| Reducer 10' to 6' | 1 | EA | 141 | 206 | \$10,000 | \$14,610 | \$14,610 | 1, page 41 |
| Bifurcation 10' to 5' | 2 | EA | 141 | 206 | \$14,000 | \$20,454 | \$40,908 | 1, page 41 |
| Timber for Tunnel Supports | 300 | MBF | | | | \$1,930 | \$579,000 | 2, item VI - w |
| Grout Drilling Holes | 18,500 | LF | | | | \$17.70 | \$327,450 | 2, item I - g |
| Standby Generator | 1 | EA | 141 | 206 | \$45,000 | \$65,745 | \$65,745 | 1, page 41 |
| Architectural Features | JOB | LS | 141 | 206 | \$300,000 | \$438,298 | \$438,298 | 1, page 41 |
| Cathodic Protection | JOB | LS | 141 | 206 | \$35,000 | \$51,135 | \$51,135 | 1, page 41 |
| Protective Coatings | JOB | LS | 141 | 206 | \$100,000 | \$146,099 | \$146,099 | 1, page 41 |
| SUBTOTAL | | | | | | | \$24,245,392 | |
| Increase Capacity from 1,500 cfs to 5,000 cfs, factor cost by $(5,000/1,500)^{3/8} = 1.57$ | | | | | | | | |
| SUBTOTAL OUTLET WORKS | | | | | | | \$38,063,363 | |

Table 2b
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|--|----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|------------------------|
| IV. SPILLWAY | | | | | | | | |
| Mobilization | JOB | LS | 143 | 186 | \$300,000 | \$390,210 | \$390,210 | 1, page 44 |
| Drill Grout Holes | 1,150 | LF | | | | \$18.70 | \$21,505 | 2, item I-g |
| Grout Connections | 19 | EA | 143 | 186 | \$25.00 | \$33.00 | \$627 | 1, page 44 |
| Grouting | 29 | CY | 143 | 186 | \$280 | \$364 | \$10,556 | 1, page 44 |
| Grout Pipe | 85 | LF | 132 | 159 | \$8.00 | \$10.00 | \$850 | 1, page 44 |
| Excavation (blasting) | 906,000 | CY | | | | \$7.66 | \$6,939,960 | 2, item V-b3 |
| Excavation | 311,000 | CY | | | | \$4.03 | \$1,253,330 | 2, av. item IIa, IIIa |
| Rock Riprap | 2,500 | CY | | | | \$31.64 | \$79,100 | 2, item I-n |
| Granular Backfill | 7,300 | CY | | | | \$45.09 | \$329,157 | 2, item II-n |
| Structural Backfill | 10,100 | CY | 143 | 186 | \$20.00 | \$26.00 | \$262,600 | 1, page 44 |
| Compacted Backfill | 55,900 | CY | | | | \$8.17 | \$456,703 | 2, item III-f |
| Aggregate Base | 600 | TON | | | | \$19.15 | \$11,490 | 2, item V-d |
| Asphalt Concrete | 500 | TON | | | | \$58.92 | \$29,460 | 2, item V-e |
| Mass Concrete | 7,750 | CY | | | | \$293 | \$2,271,448 | 2, item III-d |
| Structural Concrete | 25,900 | CY | | | | \$401 | \$10,393,929 | 2, av. item IIIh, IIIc |
| Embedded Metal | JOB | LS | 143 | 186 | \$35,000 | \$45,524 | \$45,524 | 1, page 44 |
| Misc. Metal | JOB | LS | 143 | 186 | \$50,000 | \$65,035 | \$65,035 | 1, page 44 |
| Radial Gate (20' x 30') | 2 | EA | 143 | 186 | \$270,000 | \$351,189 | \$702,378 | 1, page 44 |
| Radial Gate Hoist Assembly | 2 | EA | 143 | 186 | \$90,000 | \$117,063 | \$234,126 | 1, page 44 |
| Stop Log (6' x 21') | 12 | EA | 143 | 186 | \$14,000 | \$18,210 | \$218,520 | 1, page 44 |
| Stop Log Storage Rack | JOB | LS | 143 | 186 | \$20,000 | \$26,014 | \$26,014 | 1, page 44 |
| Stop Log Lifting Beam | JOB | LS | 143 | 186 | \$5,000 | \$6,503 | \$6,503 | 1, page 44 |
| Electrical Work | JOB | LS | 143 | 186 | \$30,000 | \$39,021 | \$39,021 | 1, page 44 |
| Control Building (12' x 16') | JOB | LS | 143 | 186 | \$26,000 | \$33,818 | \$33,818 | 1, page 44 |
| Standby Generator | JOB | LS | 143 | 186 | \$40,000 | \$52,028 | \$52,028 | 1, page 44 |
| SUBTOTAL SPILLWAY | | | | | | | \$23,873,892 | |
| V. RESERVOIR | | | | | | | | |
| Reservoir Clearing (Newville and Tehenn) | 1,795 | AC | | | | \$1,097 | \$1,969,115 | 2, item IV-a |
| Improvements | JOB | LS | 137 | 176 | \$30,000 | \$38,540 | \$38,540 | 1, page 47 |
| Construction Facilities | JOB | LS | 137 | 176 | \$20,000 | \$25,693 | \$25,693 | 1, page 47 |
| Excavate Overlook | 48,400 | CY | 137 | 176 | \$14.00 | \$18.00 | \$871,200 | 1, page 47 |
| Aggregate Base for Overlook | 2,000 | TON | | | | \$19.15 | \$38,300 | 2, item V-d |
| Asphalt Concrete for Overlook | 511 | TON | | | | \$58.92 | \$30,108 | 2, item v-e |
| Liquid Asphalt Prime and Seal | 85 | TON | | | | \$324.03 | \$27,543 | 2, av. item V-f&g |
| Landscaping Overlook | JOB | LS | 137 | 176 | \$24,000 | \$30,832 | \$30,832 | 1, page 47 |
| Visitor's Center | JOB | LS | 137 | 176 | \$200,000 | \$256,934 | \$256,934 | 1, page 47 |
| SUBTOTAL RESERVOIR | | | | | | | \$3,288,263 | |

Table 2b
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|---|-----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| VI. OVERLOOK ACCESS ROAD | | | | | | | | |
| Excavation | 106,000 | CY | | | | \$3.98 | \$421,880 | 2, item V-b1 |
| Class II Aggregate Base | 5,710 | TON | | | | \$19.15 | \$109,347 | 2, item V-d |
| Asphalt Concrete | 941 | TON | | | | \$58.92 | \$55,444 | 2, item V-e |
| Liquid Asphalt Prime and Seal Coat | 157 | TON | | | | \$324 | \$50,873 | 2, av. item V-f&g |
| Guard Rail | 2,650 | LF | 160 | 237 | \$20.00 | \$30.00 | \$79,500 | 1, page 50 |
| 18 " CMP | 180 | LF | | | | \$44.78 | \$8,060 | 2, item V-j |
| 24 " CMP | 490 | LF | | | | \$53.53 | \$26,230 | 2, item V-k |
| 30 " CMP | 200 | LF | 160 | 237 | \$45.00 | \$67.00 | \$13,400 | 1, page 50 |
| Structure Excavation | 350 | CY | 160 | 237 | \$12.00 | \$18.00 | \$6,300 | 1, page 50 |
| Structure Backfill | 270 | CY | 160 | 237 | \$20.00 | \$30.00 | \$8,100 | 1, page 50 |
| SUBTOTAL OVERLOOK ACCESS ROAD | | | | | | | \$779,133 | |
| VII. ROAD RELOCATIONS | | | | | | | | |
| Newville to Paskenta | | | | | | | | |
| 48 " CSP | 140 | LF | 146 | 219 | \$60.00 | \$90.00 | \$12,600 | 1, page 51 |
| 26 " CSP | 240 | LF | 146 | 219 | \$40.00 | \$60.00 | \$14,400 | 1, page 51 |
| 24 " CSP | 160 | LF | 146 | 219 | \$30.00 | \$45.00 | \$7,200 | 1, page 51 |
| 18 " CSP | 570 | LF | 146 | 219 | \$25.00 | \$38.00 | \$21,660 | 1, page 51 |
| Structure Excavation | 4,700 | CY | 146 | 219 | \$25.00 | \$38.00 | \$178,600 | 1, page 51 |
| Structure Backfill | 4,400 | CY | 146 | 219 | \$45.00 | \$68.00 | \$299,200 | 1, page 51 |
| Roadway Excavation | 1,033,000 | CY | | | | \$3.98 | \$4,111,340 | 2, item V-b1 |
| Aggregate Base | 31,000 | TON | | | | \$19.15 | \$593,650 | 2, item V-d |
| Asphalt Concrete | 15,000 | TON | | | | \$58.92 | \$883,800 | 2, item V-e |
| Down Drains | 24 | EA | 146 | 219 | \$1,000 | \$1,500 | \$36,000 | 1, page 51 |
| Fence | 66,800 | LF | 146 | 219 | \$2.00 | \$3.00 | \$200,400 | 1, page 51 |
| SUBTOTAL NEWVILLE TO PASKENTA ROAD | | | | | | | \$6,358,850 | |
| Cattle Crossings (6 total) | | | | | | | | |
| 11' - 5" x 73 " Multiple Steel Pipe | 432 | LF | 146 | 219 | \$180 | \$270 | \$116,640 | 1, page 51 |
| Structure Excavation | 1,710 | CY | 146 | 219 | \$25.00 | \$38.00 | \$64,980 | 1, page 51 |
| Structure Backfill | 1,100 | CY | 146 | 219 | \$45.00 | \$68.00 | \$74,800 | 1, page 51 |
| SUBTOTAL CATTLE CROSSINGS | | | | | | | \$256,420 | |
| Round Valley Road | | | | | | | | |
| 48 " CSP | 300 | LF | 146 | 219 | \$60.00 | \$90.00 | \$27,000 | 1, page 51 |
| 24 " CSP | 2,120 | LF | 146 | 219 | \$30.00 | \$45.00 | \$95,400 | 1, page 51 |
| Roadway Excavation | 233,000 | CY | 146 | 219 | | \$3.98 | \$927,340 | 2, item V-b1 |

Table 2b
ESTIMATED COSTS
THOMES-NEVILLE RESERVOIR PROJECT (3.08 MAF)

| DESCRIPTION | QUANTITY | UNIT ^a | USBR INDEX JAN. 81 | USBR INDEX OCT. 96 | UNIT COST JAN. 81 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|--|-----------|-------------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| Structure Excavation | 2,000 | CY | 146 | 219 | \$25.00 | \$38.00 | \$76,000 | 1, page 51 |
| Structure Backfill | 1,600 | CY | 146 | 219 | \$45.00 | \$68.00 | \$108,800 | 1, page 51 |
| Aggregate Base | 9,100 | TON | | | | \$19.15 | \$174,265 | 2, item V-d |
| Asphalt Concrete | 4,400 | TON | | | | \$58.92 | \$259,248 | 2, item V-e |
| Down Drains | 12 | EA | 146 | 219 | \$1,000 | \$1,500 | \$18,000 | 1, page 51 |
| Fence | 20,000 | LF | 146 | 219 | \$2.00 | \$3.00 | \$60,000 | 1, page 51 |
| Compacted Embankment and Overhaul | 211,000 | CY | | | | \$1.36 | \$286,960 | 2, item V-c1 |
| Bridge D/S of Newville Spillway | 6,800 | SF | | | | \$100 | \$680,000 | 3 |
| SUBTOTAL ROUND VALLEY ROAD | | | | | | | \$2,713,013 | |
| Chrome to Burrows Gap Road | | | | | | | | |
| 60 " CSP | 250 | LF | 146 | 219 | \$70.00 | \$105 | \$26,250 | 1, page 52 |
| 24 " CSP | 920 | LF | 146 | 219 | \$30.00 | \$45.00 | \$41,400 | 1, page 52 |
| Roadway Excavation | 202,000 | CY | | | | \$3.98 | \$803,960 | 2, item V-b1 |
| Structure Excavation | 1,600 | CY | 146 | 219 | \$25.00 | \$38.00 | \$60,800 | 1, page 52 |
| Structure Backfill | 1,800 | CY | 146 | 219 | \$45.00 | \$68.00 | \$122,400 | 1, page 52 |
| Aggregate Base | 9,100 | TON | | | | \$19.15 | \$174,265 | 2, item V-d |
| Asphalt Concrete | 5,300 | TON | | | | \$58.92 | \$312,276 | 2, item V-e |
| Fence | 53,000 | LF | 146 | 219 | \$2.00 | \$3.00 | \$159,000 | 1, page 52 |
| Bridge over Stony Creek Diversion | 6,800 | SF | | | | \$100 | \$680,000 | 3 |
| SUBTOTAL CHROME TO BURROWS GAP ROAD | | | | | | | \$2,380,351 | |
| SUBTOTAL ROAD RELOCATIONS | | | | | | | \$11,708,634 | |
| VIII. SADDLE DAMS | | | | | | | | |
| Mobilization | JOB | LS | 132 | 159 | \$86,000 | \$103,591 | \$103,591 | 1, page 54 |
| Clear and Grub | 88 | AC | 132 | 159 | \$4,000 | \$4,818 | \$423,984 | 1, page 54 |
| Foundation Excavation | 2,572,300 | CY | | | | \$3.23 | \$8,308,529 | 2, item I-d |
| Drill Grout Holes | 79,470 | LF | | | | \$18.70 | \$1,486,089 | 2, item I-g |
| Grout Connections | 1,470 | EA | 132 | 159 | \$50.00 | \$60.00 | \$88,200 | |
| Grouting | 1,970 | CY | 132 | 159 | \$280 | \$337 | \$663,890 | |
| Grout Pipe | 6,620 | LF | 132 | 159 | \$8.00 | \$10.00 | \$66,200 | |
| Borrow - Impervious Material | 5,194,600 | CY | | | | \$3.22 | \$16,726,612 | 2, item I-e |
| Filter and Drain Material | 782,860 | CY | | | | \$8.54 | \$6,685,624 | 2, item I-i&j |
| Riprap | 195,420 | CY | | | | \$31.64 | \$6,183,089 | 2, item I-n |
| Riprap Bedding | 97,710 | CY | | | | \$1.79 | \$174,901 | 2, item I-m |
| Placed Impervious | 4,723,700 | CY | | | | \$0.95 | \$4,487,515 | 2, item I-f |
| Instrumentation | JOB | LS | 132 | 176 | \$50,000 | \$66,667 | \$66,667 | 1, page 54 |
| SUBTOTAL CONVEYANCE FACILITIES | | | | | | | \$45,464,891 | |

Table 2b
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX OCT. 79 | USBR INDEX OCT. 96 | UNIT COST OCT. 79 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|--|----------|-------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| IX. THOMES CREEK DIVERSION FACILITIES | | | | | | | | |
| Diversion Structure | JOB | LS | 121 | 207 | \$7,940,000 | \$13,583,306 | \$13,583,306 | 4, page 4-13 |
| Intake Structure | JOB | LS | 122 | 213 | \$1,150,000 | \$2,007,787 | \$2,007,787 | 4, page 4-13 |
| Canal and Roads | JOB | LS | 120 | 199 | \$21,740,000 | \$36,052,167 | \$36,052,167 | 4, page 4-13 |
| SUBTOTAL THOMES CREEK DIVERSION FACILITIES | | | | | | | \$51,643,260 | |
| DESCRIPTION | QUANTITY | UNIT* | USBR INDEX APR. 80 | USBR INDEX OCT. 96 | UNIT COST APR. 80 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
| X. CONVEYANCE FACILITIES | | | | | | | | |
| Tehama Colusa Canal Turnout | JOB | LS | | | | \$1,543,000 | \$1,543,000 | 3 |
| Sour Grass Canal | JOB | LS | 127 | 199 | \$13,220,222 | \$20,715,151 | \$20,715,151 | 4- page 9-17 |
| Sour Grass Pumping-Generating Plant Q=5,000 cfs, TDH = 115 ft., HP = 86,983 | JOB | LS | | | | \$121,911,000 | \$121,911,000 | 3 |
| Black Butte Canal, factored by (5,000/10,000) ^{3/8} | JOB | LS | 127 | 199 | \$15,453,000 | \$24,213,756 | \$24,213,756 | 4- page 9-17 |
| Black Butte Pumping-Generating Plant Q=5,000 cfs, TDH = 144 ft., HP = 108,918 | JOB | LS | | | | \$139,522,000 | \$139,522,000 | 3 |
| Tehenn Canal, factored by (5,000/3,000) ^{3/8} | JOB | LS | 127 | 199 | \$47,658,000 | \$74,676,709 | \$74,676,709 | 4- page 5-19 |
| Tehenn Reservoir | JOB | LS | 127 | 176 | \$29,010,000 | \$40,202,835 | \$40,202,835 | 4- page 5-19 |
| Tehenn Pumping-Generating Plant Q=5,000 cfs, TDH = 190 ft., HP = 143,711 | JOB | LS | | | | \$164,770,000 | \$164,770,000 | 3 |
| Newville Pumping-Generating Plant Q=5,000 cfs, TDH = 380 ft., HP = 287,422 | JOB | LS | | | | \$249,744,000 | \$249,744,000 | 3 |
| SUBTOTAL CONVEYANCE FACILITIES | | | | | | | \$837,298,451 | |

Table 2b
ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

| DESCRIPTION | QUANTITY | UNIT ¹ | USBR INDEX APR. 80 | USBR INDEX OCT. 96 | UNIT COST APR. 80 | UNIT COST OCT. 96 | TOTAL COST OCT. 96 | COST REFERENCE |
|--|----------|-------------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|-------------------|
| SUB TOTAL FOR THOMES-NEWVILLE | | | | | | | | |
| CONTINGENCIES @ 20% | | | | | | | \$1,198,600,000 | |
| ESTIMATED CONSTRUCTION COST | | | | | | | \$239,700,000 | |
| ENG., LEGAL, AND ADM. @ 35% | | | | | | | \$1,438,300,000 | |
| ESTIMATED CAPITAL COST FOR THOMES-NEWVILLE | | | | | | | \$503,400,000 | |
| | | | | | | | \$1,941,700,000 | |
| ESTIMATED CAPITAL COST RANGE FOR THOMES-NEWVILLE | | | | | | | | |
| LOW (-10%) | | | | | | | \$1,748,000,000 | |
| HIGH (+15%) | | | | | | | \$2,233,000,000 | |

Footnotes:

¹CY=cubic yard; LB=pound; EA=each; LS=lump sum; LF=linear foot; SF=square foot; TON=ton; MI=mile; AC=acre

Cost Reference:

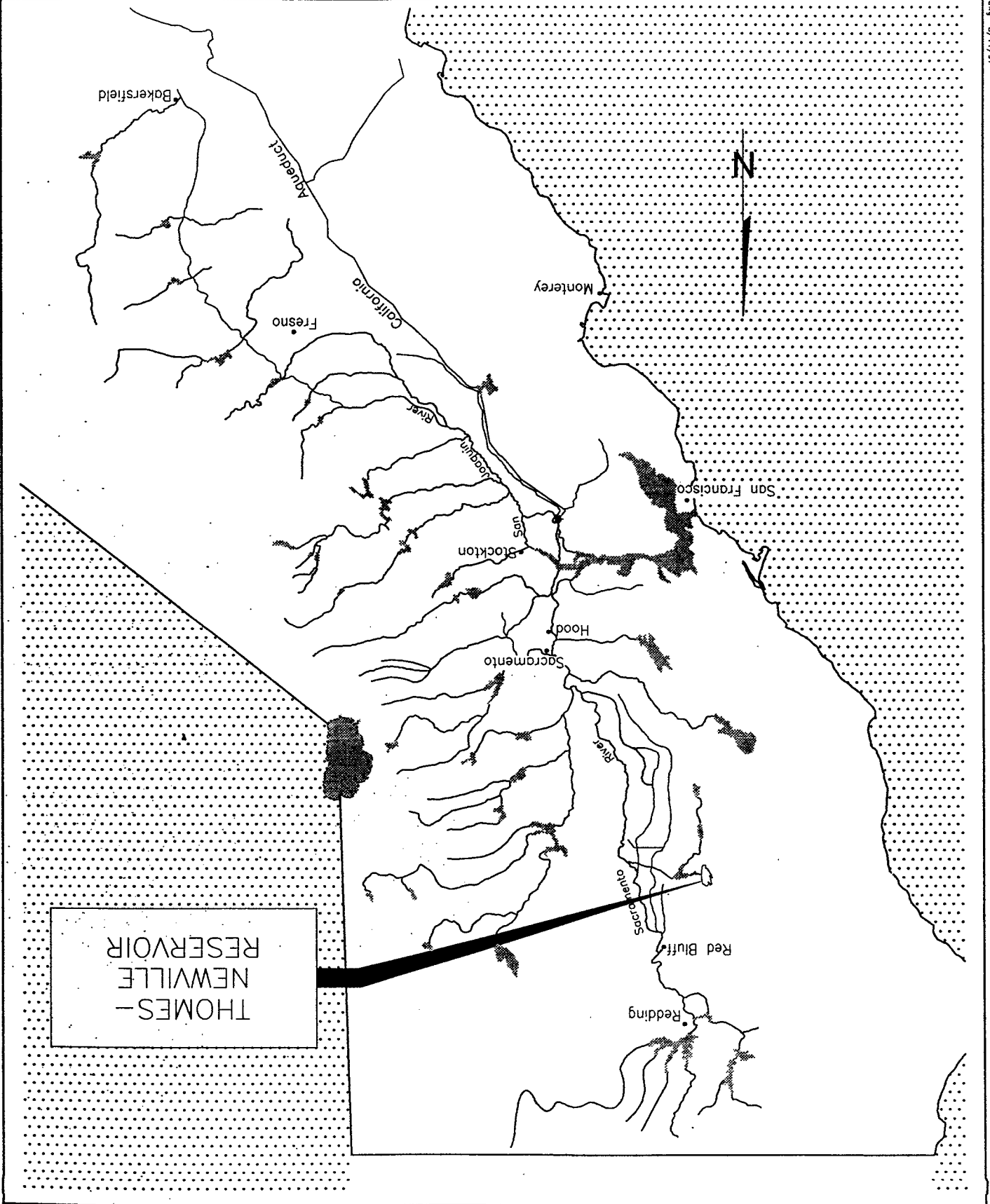
1. California Department of Water Resources, *SWP Future Supply Program, Thomes-Newville Plan*, September 1981.
2. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates*, December 1990.
3. Cost developed by Bookman-Edmonston Engineering.
4. California Department of Water Resources, *Thomes-Newville and Glenn Reservoir Plans - Engineering Feasibility*, November 1980.
5. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.

Table 3
SUMMARY OF ESTIMATED COSTS
THOMES-NEWVILLE RESERVOIR

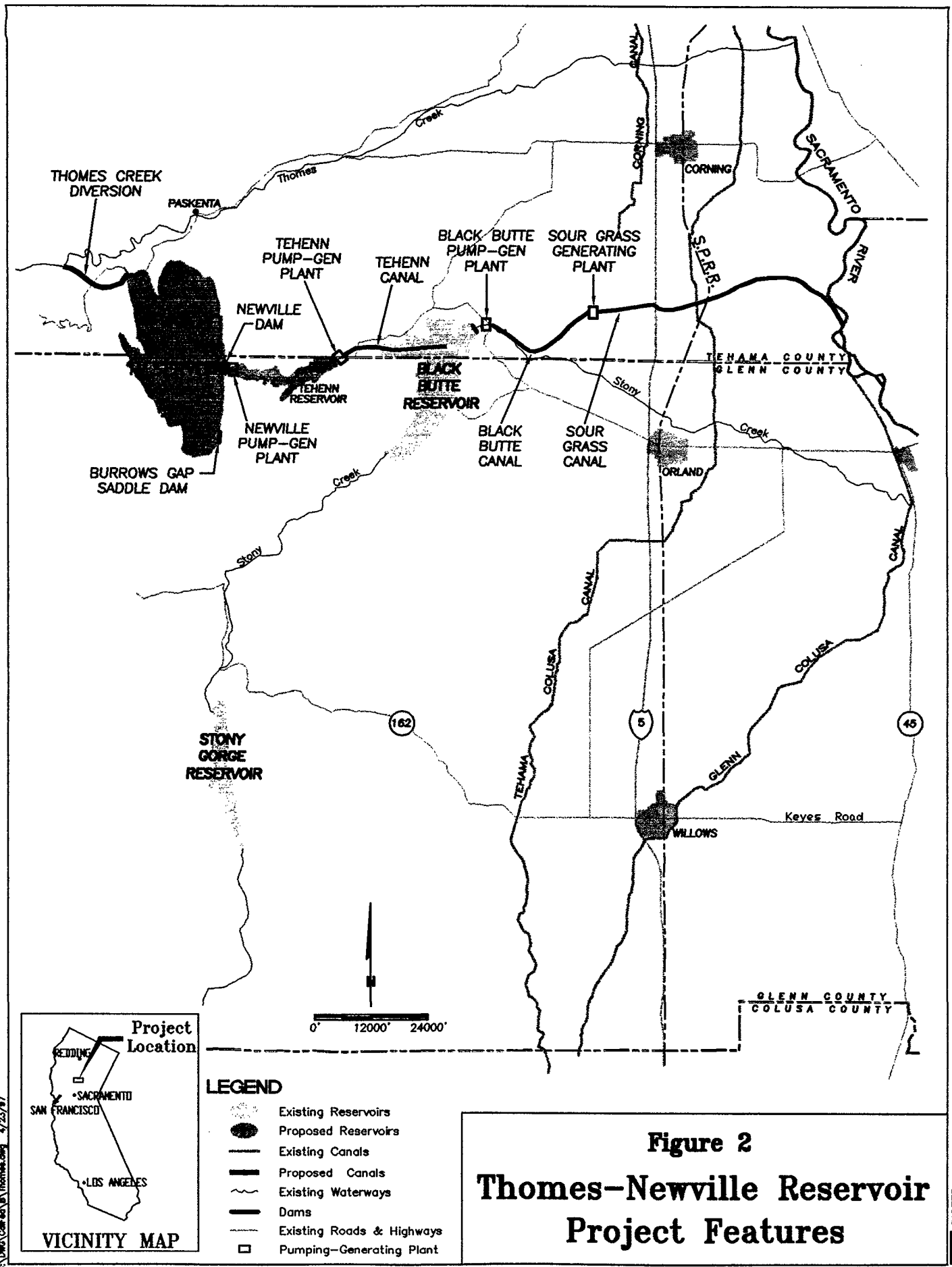
| Cost Item | Estimated Costs (\$Millions) | |
|--|------------------------------|-------------------|
| | 1.84 MAF | 3.08 MAF |
| Land | 30.5 | 36.0 |
| Dam | 99.0 | 150.4 |
| Outlet Works | 38.1 | 38.1 |
| Spillway | 19.5 | 23.9 |
| Reservoir | 3.0 | 3.3 |
| Overlook Access Road | 0.8 | 0.8 |
| Road Relocations | 11.7 | 11.7 |
| Saddle Dams | 1.7 | 45.5 |
| Thomes Creek Diversion Facilities | 54.9 | 51.6 |
| Conveyance Facilities | 804.3 | 837.3 |
| SUBTOTAL | 1061.6 | 1198.6 |
| Contingencies (20%) | 212.3 | 239.7 |
| ESTIMATED CONSTRUCTION COST | 1273.9 | 1438.3 |
| Engineering, Legal, and Project Administration (35%) | 445.9 | 503.4 |
| ESTIMATED TOTAL CAPITAL COST | 1,719.8 | 1,941.7 |
| Capital Cost Range (minus 10% - plus 15%) | \$1,548 - \$1,948 | \$1,748 - \$2,233 |



Figure 1
Project Location Map
Thomes-Newville Reservoir



THOMES-
NEWVILLE
RESERVOIR



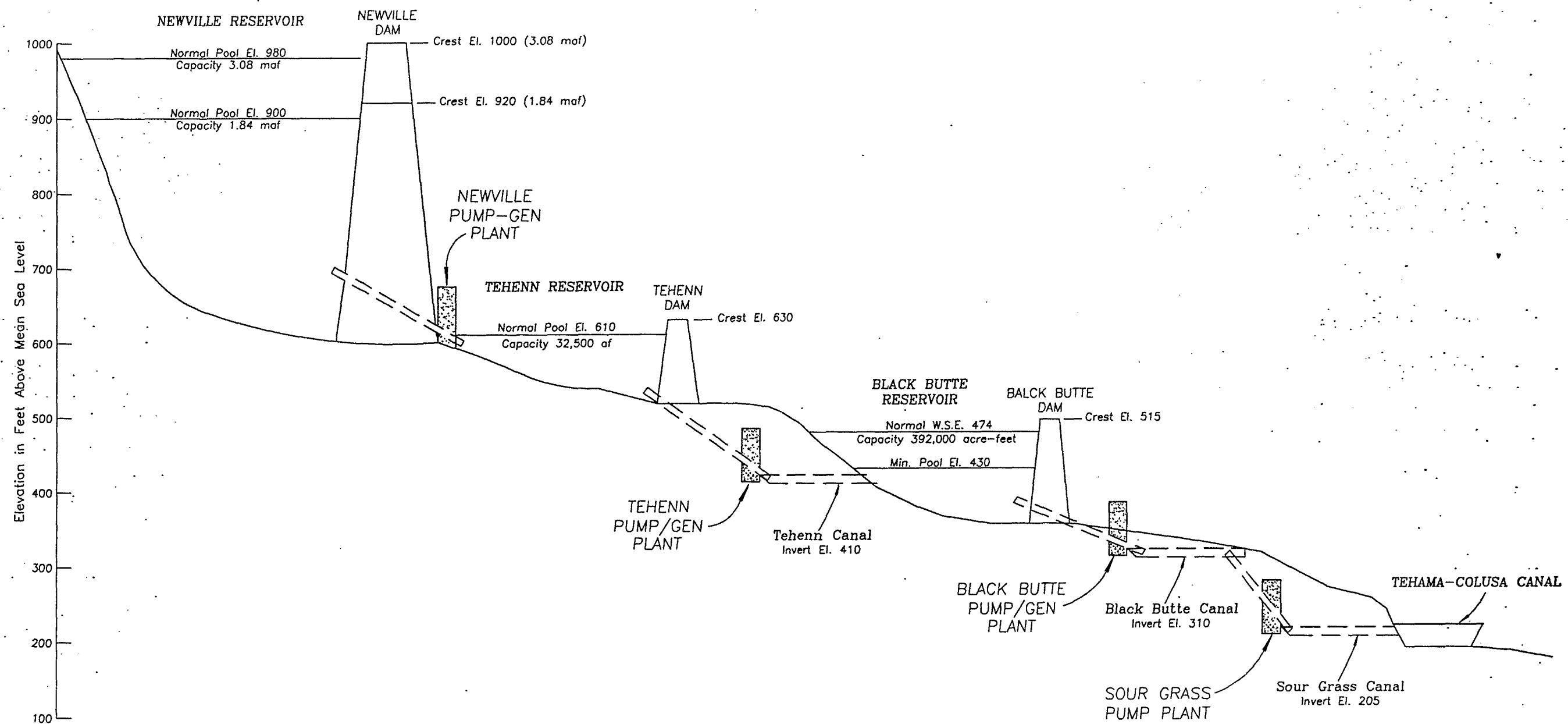


Figure 3
 Thames-Newville
 Reservoir Plan
 Schematic Profile

